Vol. XXII, No. 2
MARCH 1955

THE SCIENCE TEACHER

1955 Annual National Convention

CINCINNATI · March 24-26

- Pasteur's Attempt to Disprove the Theory of Spontaneous Generation
- Elementary School Science in the Making
- Cincinnati Convention Highlights
- Evidence Awareness
- Test Tubes and Tadpoles for Science Teachers

JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

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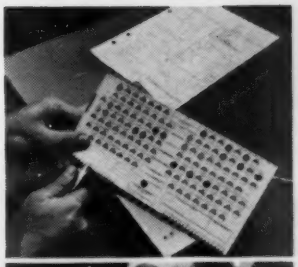

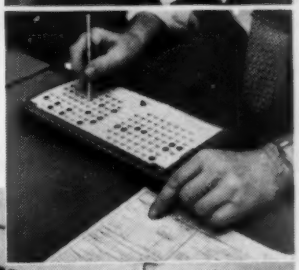

Perforated steel cards, which give directions to the Long Distance dial telephone system, are easy to keep up to date. New information is clipped (1) and punched (2) by hand on a cardboard template. This guides the punch-press that perforates a steel card (3), and the two are checked (4). The new card is put into service in the card translator (5).

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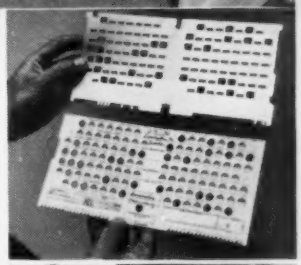

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Improving telephone service for America provides careers for creative men in scientific and technical fields.

THIS MONTH'S COVER . . . Cincinnati, site of the Third National Convention of NSTA, is pictured by a skyline view of the city taken from the northern Kentucky shores. Science teachers, scientists, science teacher trainers, administrators, representatives from business-industries, and exhibitors of science teaching aids will be meeting at the Netherland Plaza Hotel, March 24-26 for this occasion. Convention highlights and pictures of many of the participants will be found on pages 88-90 of this issue.

Readers' Column

Please tally this enclosed check toward payment of my Life Membership in NSTA. I have recently attended the Western Regional Conference held at the University of California, Berkeley, in conjunction with the 121st AAAS Meeting. Now more than ever I am proud to be a part of an organization that is doing such a fine job in advancing the knowledge and status of the science teacher.

I also received the copy of *Ford at Fifty* and wish to thank you and the Ford Motor Company for a fine book concerning the operation of one of the great industries of the United States. I plan to use the book to stimulate several fellows in my chemistry class to think about applying some of their interest in "hot rods" and cars to a vocation along that line. This book will give them an idea of one of the sides to the automobile story.

Thanks again for the fine service of *The Science Teacher* and the *Elementary School Science Bulletin*.

J. Bruce Duncan
Oakland, California

How *THE SCIENCE TEACHER* gets around! In today's mail I found a letter from a young man in Nigeria, Africa, who had read my review of *The Epidemiology of Health* in our April 1954 journal.

Colin McEwen
Hollywood, California

Just a short note to tell you how pleased we were with your reviews covering our physics films and zoology filmstrips.

I am sure that your evaluations will be of much interest to science teachers.

Sales Manager
Text Film Department
McGraw-Hill Book Company, Inc.
New York City

In the Readers' Column of the February issue of TST there is a letter from someone registering ". . . disgust and protest concerning one article". The article in question was Waldemar Kaempffert's "Can Science Create Life?" which appeared in the November 1954 issue.

Personally I found the article to be very stimulating, interesting, and worthwhile. I would be interested in the reasons why the article was disgusting, as the writer did not state them in the letter.

Milton S. Swirgen
Wagner Junior High School
Philadelphia, Pennsylvania

I thought you would appreciate hearing from another teacher with an opposite point of view from that of one reader of Waldemar Kaemppfert's article.

My friends and I found this article so interesting we decided to preserve it for posterity—perhaps 100 years or more. On February 27, 1955 I took part in laying the corner stone for Wesley Hall, First Methodist Church, Butler, Pennsylvania. This new building is to house the Church School and its related activities. Now I am sure you have guessed what happened. In the years to come when that corner stone is opened our successors will read this article and know how well the future was predicted and how well the article was written.

Nelson P. Palmer
Senior High School
Butler, Pennsylvania

Enclosed find order coupons for additional copies of two booklets from Packet XXX. I have been looking for satisfactory material for a class of 9th grade boys who are most interested in the mechanics of automobile transportation. We have no suitable text material for the subject.

After examination of Packet XXX I felt these booklets were just the answer. I hope they are still available.

Rachel Anne Early
Francis Scott Key School
Baltimore, Maryland

THE SCIENCE TEACHER

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Coming . . .

- Method in Science Teaching
- Sources of Heat in Elementary Science
- The Science Teacher and the Challenge of Cancer
- The Friendly Insect
- A Directory of Summer Programs of Study

A TIMELY MESSAGE

On March 2 the executive branch of our government figuratively wrote *V I P* after the title "science teacher." On that date the long-awaited "Revised Lists of Currently Essential Activities and Critical Occupations" were released by the Secretaries of Commerce and Labor. For the first time high school teachers of science and mathematics are included.

Those of us who have followed the revision of these lists appreciate the careful thought and research that accompanied their preparation. They are designed to guide government agencies, education, and industry in recognizing fields in which skilled personnel is critically scarce. We who work in science education know only too well how short is the supply of competent instructors in our secondary schools. Yet the decision to include teachers in the list hung in the balance for several weeks.

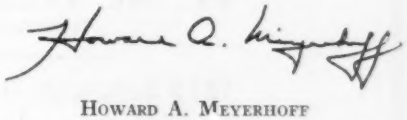
The interdepartmental committee that worked on the lists doubted that the inclusion of teachers would do anything to correct the alarming situation. Its members argued that the shortage is the result of low salaries and the low value school superintendents place upon instruction in science and mathematics. They capitulated when they were convinced of the need to conserve the limited supply we have if we are to stimulate the entry of young people into the scientific and engineering professions, and if we are to give them the basic training that will enable them to do satisfactory work in college.

The economic status of teachers needs no exposition in this brief editorial, but something might be said about the low estate into which instruction in science and mathematics has fallen. Generalization is dangerous and works some injustices, but, with exceptions that are so rare as to be outstanding, the average high school curriculum exhibits far less adjustment to the requirements of modern living than educators would have us believe. Yet the program of study is commonly called "Life Adjustment Education."

To what kind of life must youth adjust if not to the highly developed technology that makes the United States the most progressive nation in the world? Technology is founded on precision—the precision of effective speech and writing, the precision of mathematics and science. Failure to impart competence in these fields of learning deprives the bulk of our young people—who do not continue their studies—of the means of adequate communication and of a comprehension of the kind of civilization that is peculiarly American.

In Russia every high school student spends 40 per cent of his time on mathematics and science. And in addition to Russian, he studies two foreign languages. Provincial though Russia is supposed to be, life adjustment education there means adjustment to a technological age in a steadily shrinking world, where contacts with one's fellow citizens and with the nationals of other countries are vital.

Must we turn to Russia for a sound theory of secondary education and for a proper sense of values?



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Executive Director
Scientific Manpower Commission

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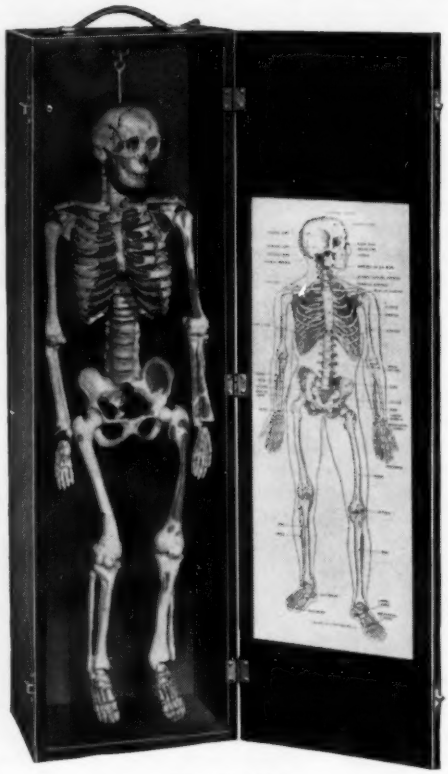

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THE SCIENCE TEACHER

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The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

The SIGNIFICA
Attempt t
The Theory o

SPONTANEOUS GENERATION was one way of explaining the origin of living things. Man's own beginning, he cannot remember, if there is anything to remember. Although he has turned his mechanically-aided eyes hopefully upon stars 22×10^{12} light years across the universe, nowhere does he find more of himself. Alone? How, then, did life come upon this Earth-atom? As his instruments measure the Finite with near exactitude, he discovers the paradox of Infinity in which mathematical equations become contradictions; and the observable familiar, a new unknown. His limited intelligence quests an Ultimate in the baffling Infinite—a source, a purpose, a pattern. Through the voiceless silence wherein his awareness tapers off, he insists "What came before the very First? What am I? Was I merely put together or am I a fragment of something greater? Whence—whither, the *I* in Time and Space?" He cannot conceive of nothingness. Conscious of his frailities, he gropes for power: creative or destructive—natural or supernatural.

Although neither Louis Pasteur nor Charles Darwin set out to become natural philosophers, the *Origin of Species* in 1858 made the origin of life more pertinent, and the Frenchman announced,[1]

> I am pursuing as best I can these studies on fermentation which are of great interest, connected as they are with the impenetrable mystery of Life and Death. I am hoping to mark a decisive step very soon by solving . . . the celebrated question of spontaneous generation. . . .

This ancient controversy, revived after the microscope brought to sight millions of questionable animalculae, had stirred the fighting blood of every cleric and scientist in Europe by proposing that small living creatures could and did emerge from the inorganic. Filling a gap between early Greece and Darwin, this theory lacked the rational purposes, vestigial stigmata and organized progress of either God's plan or natural order. For superstition-resistant thinkers it offered the only alternative to accepting blindly the supernatural creation of living things by one of a variety of myths or theologies. These philosophers preferred to leave the agnostic *Why* continually drowned in a tangible sea of ignorance, trusting more in evaporation than vanishment by decree. Spontaneous generation intrigued court, drawing room and tavern as the cult of the worldly, the legerdemain of the magician and the folk tale of the rustic. Even slaves knew that the Nile spawned worms, insects and eels, while cow dung made wasps. In Heterogeny lay freedom. Anything could happen.

Aristotle had stated that [2] "life could be started by moistening a dry substance or drying a wet one," and [3] "by the spontaneous action of Nature. . . ." Virgil thought that [4] "leaves would produce cater-

CANCE of PASTEUR'S
t to DISPROVE
y of Spontaneous Generation

By IDA MAY MECUM

Columbia High School, Richland, Washington

pillars." The naive imagination of Pliny the Elder was expressed in his Natural History: [5]

> Various circumstances in nature prove . . . that there impressed on the heavens innumerable figures of animals. . . . For we find that the seeds of all bodies fall down from it, principally into the ocean, and, being mixed together, that a variety of monstrous forms are in this way produced.

To get bees: [6]

> Take a young bullock, kill him with a knock on the head, bury him . . . in a standing position with his horns sticking out. Leave him there for a month then saw off his horns—and out will fly your swarm of bees.

Buonanni wrote of [7] "timberwood rotting in the sea which produced worms, which engendered butterflies, and those butterflies became birds."

The sage Dr. Van Helmot issued this recipe for producing rats: [8]

> . . . all that is required is to cork up a pot containing corn with a dirty shirt; after about twenty-one days a ferment coming from the dirty shirt combines with the effluvium from the wheat, the grains of which are turned into rats, not minute and puny, but vigorous and full of activity.

Although Harvey, Newton and Descartes also subscribed to the idea, the doubting Francisco Redi in 1678 demonstrated that the maggots which produced flies never formed in meat if the jars were covered. Later the daring Italian monk, Lazarro Spallanzani, refuted the claims of the English priest, John Turberville Needham, who announced that microscopic animals had been produced by him from mutton gravy. While atheists cheered Needham, the caustic Voltaire quipped,[9] "It is very strange that men should deny a creator, and yet attribute to themselves the power of creating eels."

Shocked, Needham hastened to rationalize his orthodoxy. Assisted by the precious French Count Buffon he concocted a system of force which might be either [10] "productive or vegetative." Furthermore he elaborated it until vegetative force had [11] "caused Eve to develop from Adam's rib."

Spallanzani proved that broth properly cooked and sealed was sterile indefinitely but Needham protested that the treatment had changed the broth and air so that it was incompatible with life. There the question dangled for a century.

At the time when young Pasteur listened ecstatically to the great Dumas' lectures, science was restless with its lusty offspring, technology. The Industrial Revolution was demanding proofs from the scholar and applications from the laboratory. Dalton's neat, indivisible atoms, the convenient alpha and omega of matter, were thought to have interest only for the pedant. For the organic world Schleiden and Schwann's cell theory furnished a tidy unit. As people everywhere gasped at the increasing rumble from the machinery of science, Charles Darwin [12] "introduced a fourth—Time—into taxonomy and enabled naturalists to make most interesting museum arrangements of a hypothetical Tree of Life."

Agregé chemist, Louis Pasteur aspired to find the most elusive compound of his time saying,[13] "I shall go to Trieste. I shall go to the end of the world. I *must* discover the source of racemic acid."

Like Don Quixote he set forth. Little did he suspect that this discovery would change his entire

---

Miss Mecum's paper was written in connection with degree courses being taken at Teachers College, Columbia University. Dr. Hubert M. Evans is her adviser.

life. Not only did he find racemic acid, but he learned how to make it by keeping chinchone tartrate at a high temperature. Jubilantly he experimented. One day he broke off part of an eight-sided crystal and dropped the remainder into the "mother liquor." How perfectly the original structure was re-formed—just as the body rebuilds wounded tissue! How exciting! From cosmic heights he surmised:[14]

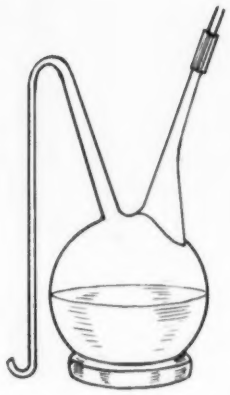
> I am inclined to think that life . . . must be a function of the disymmetry of the universe and of the consequences it produces. . . . A luminous ray never strikes in a straight line the leaf where life creates organic matter. Terrestrial magnetism . . . that offered us by the two electricities . . . are but the resultants of disymmetrical actions and movements . . . I can even foresee that all living species are primordially, in their structure, in their eternal forms, functions of cosmic disymmetry.

Origins? He was on the track of Creation!

One of his earliest discoveries was that ordinary tartrate of ammonia, of which racemic acid is a part, does not show polarity because of the neutralizing effects of its left-handed or right-handed crystals. In the presence of sodium and potassium these mirror opposites behave exactly alike and have the same stability, but when they unite with colloids of albumen, which have rotary power, they become different. Had Pasteur only been able to glimpse into the next century with its instruments to check the radioactivity of potassium and the electrical field it sets up which activates cell life, he might never have departed from this chemistry laboratory. After mixing ammonium tartrate with Liebig's albumin nutrient Pasteur soon noticed the cloudiness of a living ferment mostly Penicillium glaucum. He examined a sample under the microscope. To his amazement the plane of polarized light was now turning to the left; also, the right-handed tartrate was disappearing! Although both tartrates were of the same composition, the living organism chose one for food, and rejected the other.

Contrary to Liebig, Pasteur now suspected that fermentation resulted from the action of microorganisms. He wrote to Liebig, but the German did not respond. He conducted dozens of experiments feeling always surer of himself. He shared his wonderful conjectures with Marie, his wife, who listened entranced. If, as he believed, the whirling planets of the universe were functions of disymmetry, and life was related to the light and movement thereof, who knows but what one might alter species; might even create life!

Between huge magnets Pasteur constructed an intricately geared apparatus for rotating plants



Flask used by Pasteur in his study of the transformation of species.

simultaneously in opposite directions. Using a large mirror controlled by a heliostat, he reflected the inverted solar rays upon the moving plants. Perhaps this might reverse their molecular structures. He swung them back and forth in a pendulum. Hopefully, but patiently he varied the light in every conceivable way. He repeated and checked continually. Time passed unnoticed. The fantastic miracle which might happen kept him at his work night after night. Why did not the molecules change as he wanted them to change?

Today experts agree that he was [15] "right when he postulated a close relation between optical activity and life," but after many experiments he concluded that: [16]

> . . . disymmetric forces different from those of the laboratory are the agents of vitality and baffle the chemist to produce them. Such molecules trace their ancestry to life alone.

While Pasteur was teaching at Lille, the son of a wine merchant, M. Bigo, asked why the expensive alcohols kept turning into cheap vinegar. To the young professor this was a new and stimulating question. Although Man's knowledge of fermentation was of ancient vintage, his explanations hitherto had been philosophical rather than scientific. With enthusiasm and thoroughness Pasteur attacked the problem. He studied the roundish yeast plants and the slender rods of lactic acid bacteria which destroyed them. He watched them grow, then bud or divide, and noted that each invariably produced its own kind. At last he seemed to be on the right track. He developed a method for preventing the growth of the rods. Then he announced: [17]

> In order to introduce into a cell proximate principles different from those which exist there, it would be necessary to . . . take the germ cell and try to

> modify it. But this cell has received from its parents a heredity . . . to impart to its evolution the beginning not only of its *being* but also its *becoming*. . . .

Imagine Pasteur's astonishment then in December, 1858 when he read Felix Archimede Pouchet's *Note on Vegetable and Animal Proto-organisms Spontaneously Generated in Artificial Air and Oxygen Gas*. M. Pouchet, director of the Natural History Museum of Rouen, was soon abetted by Nicolas Joly, M.D., physiology professor at Toulouse, and his protégé, Charles Musset, then preparing a doctorial thesis on *New Experimental Researches on Heterogenia or Spontaneous Generation*. By meditation Pouchet had decided that fermentation was caused by the motion of molecules broken down by putrefication and the corresponding motions they set off in fermentable substances. In uncontaminated, artificial air, these molecules supposedly regrouped themselves into Infusoria.

Before long, Pouchet's second volume, *Heterogenie*, appeared. Here was a problem worthy of genius. At the Sorbonne later Pasteur stated its implications:[18]

> Great problems are now being considered and every thinking man is in suspense; the unity or variety of human races; the creation of man a thousand years or a thousand ages ago, and fixity of the species, or the slow and progressive development of one species into another; the eternity of matter; the doctrine of an unnecessary God. . . .

Had not he, Pasteur, tried in vain to create life? Had not he watched butyric acid bacteria die in air?

He wrote to Pouchet:[19] "What is it in the air that provokes organization? Germs? Solid bodies? Gas? Fluid? Is it a principle such as ozone? All this is unknown and invites experiment."

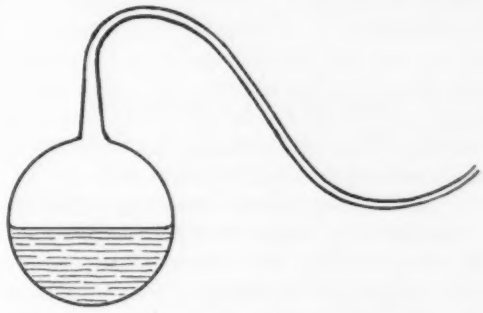
If oxygen were the prime factor in the genesis of microbes, as Pouchet claimed, heating and filtration should not affect its ability to reorganize the putrescent molecules, since these processes did not change the elemental nature of the gas. Pasteur boiled flasks of decomposing liquid until all were sterile. Now if Pouchet's claims were true, the dead matter would spring into life and microbes would appear. Just as Pasteur thought, they did not. Next he contrived an aspirator-like tube stuffed with cotton through which he filtered out the solids and microbes (he believed) from the air. Carefully he opened one of the sterile flasks, inserted the cotton plug and resealed it. Inside of twenty-four hours, the fluid thus seeded, became cloudy with millions of living organisms.

Pouchet ridiculed these experiments. Maybe the microbes were produced by the organic nature of the plug. Pasteur repeated his experiments using asbestos plugs. The results were the same. Perhaps the boiling had vitiated the broth and air. This had been Spallanzani's stumbling block, and Pasteur found it hard to disprove. Finally at Balard's suggestion he drew the necks of his flasks out into a swan shape which would keep out dust, but allow for the entry of air. The contents of these flasks remained sterile indefinitely. In 1860 Pasteur delivered his *Experiments Relating to Spontaneous Generation,* concluding:[20]

> Gases, fluids, electricity, magnetism, ozone, things known and things occult, there is nothing in the air which is conditional to life except the germs it carries.

Pouchet called this idea absurd. Why, if this were so, he argued, microbes would make the air as dense as[21] "iron". Pasteur sterilized more flasks and sealed them while hot. He would tell Pouchet how many microbes existed in various places. He took his flasks about Paris: the cellar of the observatory, the yard of the Ecole, a dusty street. Holding them high to avoid dust from his clothing, he used flamed pliers to snap their necks. The air rushed in. He resealed them and went back to the stuffy cubby-hole that was his laboratory where he processed and examined them. Only those opened where the dust was moving showed many microbes. In his prize-winning *Sur les corpuscules qui existent dans l'atmosphere* he postulated that germs on suspended dusts are responsible for ferments and Infusoria.

Pouchet then suggested that Pasteur might be passing off granules of starch or sand for the germ cells of his microbes. Caustically Pasteur advised naturalists to use the experimental method rather than the speculative for improving their techniques. Pouchet reiterated that just the same[22] "air (was) equally favorable to organic genesis,



Swan-neck flask used by Pasteur in his study of spontaneous generation.

whether surcharged with detritus in the midst of our populous cities, or taken on the summit of a mountain."

On his next vacation Pasteur took his family to his old home in Arbois near the Jura Mountains. With him he took seventy-three sealed, sterile flasks of yeast water, a blowpipe, spirit lamp and other equipment. Ignoring the danger of his enterprise, he tells us of his chief difficulty: [23]

> . . . The glare of the ice in the sunlight made it impossible to distinguish the jet of burning alcohol slightly moved by the wind which never stopped long enough for a point to hermetically seal the flask. All the ways I might have used to make the flame visible and thus directable would inevitably have caused error.

So he had to return to the Montavert Inn and try again after he had improved his spirit lamp. His total results might have been tabulated thus:

Place	*Number Opened*	*Number With Germs*
Near Arbois	20	8
Mt. Poupet	20	5
Montavert	13	All lost: Couldn't seal
(Swiss Alps)	20 (next day)	1

Not to be outdone, Pouchet and his friends repeated the experiment using four vessels of hay infusion instead of the seventy-three flasks of yeast water. They climbed the glaciers of Maladetta which were a thousand meters higher than Montavert. A guide pulled Joly by the coat tail from the brink of death in a crevasse. Pouchet reported triumphantly that his flasks still teemed with microbes, proving that air, no matter how clean or dirty, was the only condition needed for organic genesis. In the same year Pasteur's *Examen de la doctrine des generations spontanees* was published and the dispute became torrid.

Pouchet referred to the [24] "wise professor of the Normal School" who [25] "presented his flasks as the ultimatum to science, speaking by their results to amaze the world." Pasteur demanded a [26] "public rectification." Violence seemed imminent when Pouchet and his friends challenged Pasteur to a public demonstration to prove that any flask opened for a minute would fail to grow microbes as he said it might. Since heat-resistant bacterial spores are usually present in hay infusions and not in yeast water, both scientists were reporting correct results, and the decision might easily have been a draw until nearly twenty years later. The Academy of Science appointed Flourenz, Milne, Brogniart, Edwards and Balard to act as judges, and set the trial for March. Pouchet postponed the test until June saying the weather would be more favorable then. Pasteur said that a stove would fix the weather and his experiments would work in any season. On the appointed day Pouchet's crowd appeared late, quibbled about the rules and departed. Pasteur did his experiments and was declared the winner. At the Sorbonne he declaimed: [27]

> I have taken this drop of water from the immensity of creation, full of fecund (protoplasmic) jelly appropriate to the development of inferior beings. And I wait, I observe, I beg and I demand it to recommence the primeval creation for me. It must have been beautiful! But it is silent, silent these many years since these experiments were begun. Why? Ah! because I have kept from it the one thing it has not been given for man to produce . . . the germs which float through the air, I have kept it from life for life is a germ and a germ is life. Never will the theory of spontaneous generation recover from the mortal blow of this simple experiment.

Nevertheless, in 1872 Dr. Henry Bastian of London published a tome of 1115 pages called *The Beginnings of Life: Being Some Account of the Nature, Modes of Origin, and Transformation of Lower Organisms* in which he asserted that Pasteur had overlooked that acid urine heated to 110 degrees Centigrade remained sterile if kept away from air, but when sterile potash dissolved in distilled water was added, microbes would appear. Pasteur examined the distilled water and reported it to be contaminated. He wrote: [28]

> Although we have common results there is a difference in interpretation. . . . You say it proves spontaneous generation. . . . I say it shows certain germs of inferior organisms are resistant to a temperature of 100 degrees . . . it would be absurd to pretend that the prime moven of life is caustic potash.

By this time spore-forming bacteria had been recognized.

Passionately he wrote to Dr. Bastian: [29]

> Do you know why I desire so much to fight and conquer you? It is because you are one of the principal exponents of a medical theory which I think is fatal to progress in the art of healing . . . the theory of the spontaneity of all diseases.

Why had this crusader who had aspired to the power of a God, now contented himself with the role of a Savior? As his beloved parents and three young daughters, Jeanne, Cecile and Camille had died we can be sure the scientist asked through his grief, "Did this have to be?" As paralysis

(Please continue on page 97)

Elementary School Science in The Making

By MARY LOWDEN
Curriculum Coordinator, Elementary Schools, Richmond, California
and ROBERT STOLLBERG
Professor of Science and Education, San Francisco State College, San Francisco, California

"WHAT! Another exhibit to plan and build; furthermore, I guess we will be expected to attend. You know what will happen. We'll spend hours on exhibits and no one will come."

"You know, my children get so excited I can't do anything with them when they are asked to build something according to specifications."

"Oh well, I love to teach science and maybe if I start now to plan this experiment with my children, I can help them to complete a worthwhile science project for display at the Richmond meeting."

These are the kinds of thoughts which go through the minds of teachers when they are asked to prepare materials for exhibition. But imagine what goes on in the thinking of those directly responsible for the planning of the entire meeting, in this case, an all-day Saturday gathering of a large and energetic science teachers' organization. For a really good job, this planning starts months in advance.

AT THIS TIME OF YEAR, many teachers are "up to their ears" in planning science meetings, exhibits, and teachers' institutes. Some of these events have been "in the works" since last fall. Others are just now getting under way.

Here is a description of what one group did. The place—Richmond, California, on the east shore of San Francisco Bay; the occasion—the annual fall meeting of the Elementary School Science Association of Northern California. This organization is a young group of teachers, supervisors, and administrators who are interested in science education in grade schools.

This article is presented to help those who are planning similar enterprises of their own. The authors who describe this situation are two of those who knew it best—MARY LOWDEN, *General Chairman*, and ROBERT STOLLBERG, *President of the Association*. (EDITOR'S NOTE: This Association is one of the newest additions to the growing list of NSTA's affiliated groups.)

Early Planning

During the spring of 1953, a few of the teachers and administrators in Richmond, California, approached School Superintendent Dr. George D. Miner on the subject of being host to the fall meeting of the Elementary School Science Association of Northern California. Receiving his enthusiastic support, they then presented their official invitation to the Association's Executive Council for consideration. This was in turn taken to the general meeting in May for formal acceptance. The date was set for Saturday, October 10. But active preliminary planning for the big event began that same afternoon in May.

To begin with, the General Chairman called a series of joint meetings involving a few of Richmond's key personnel and the Association's Executive Council. Thus, before the school year was over, the general policies and program for October were discussed and established.

Organization of Personnel

Once the over-all plan for the meeting was established, the people in Richmond literally "took over." The Association has established the policy that the hosts for each semi-annual meeting do much more than merely provide a site for the group. Actually, the local personnel are almost completely responsible for the entire affair. Even the Association's Executive Council serves in little more than an

advisory capacity. Fresh new teams are involved with successive meetings.

Probably the most significant feature of the planning of this meeting was the tremendous number of local teachers involved. Approximately *two hundred* teachers from Richmond and surrounding areas served on the many committees to which responsibility was delegated. This extensive involvement of personnel was deliberate, of course. For one thing, there was a tremendous amount to do and "many hands make light work." Again, it was realized that every committee worker is by nature a publicity agent, hence this wide scale involvement in planning would greatly enhance attendance. But perhaps most important of all, the educational leaders in Richmond viewed the entire operation as one of in-service teacher education, and they desired to give to as many of their teachers as possible the benefits of this kind of experience.

Committee Functions

Housing and Arrangements. The committee selected the Richmond Union High School as the meeting site. The school auditorium was used for the general meetings, the hallways for registration and commercial displays, and classrooms for educational exhibits. Morning coffee and pastry were served from the administrative offices, and lunch was provided in the school cafeteria. There are some disadvantages to using high schools for functions of this kind; the atmosphere is often too mature to carry the idea of instruction at the elementary level. Also, educational exhibits in a single large room have more of an impact than when divided into small compartments. But in typical cases, gym floors must be protected from large crowds, and in this instance, the school cafeteria was otherwise scheduled. But in spite of these minor shortcomings, the high school proved to be a very satisfactory location.

Publicity. This committee provided copy for two mailings to publicize the meeting. One mailing went to all members of the Association and was timed for delivery about five weeks prior to the meeting date. The second mailing, some three weeks later, was made with the cooperation of the California State Department of Education, which office has put its encouragement and support to the Association during and since its formation. This second mailing was larger than the first and included many administrators and supervisors not on the list of Association members. Luncheon reservation forms were included in these mailings.

In addition, the publicity committee placed notices in state educational publications and in district superintendents' bulletins. Radio and newspaper announcements were arranged by the Director of Public Relations for the Richmond Schools. The following Saturday one of the local newspapers, *The Richmond Independent,* featured a full-page photographic essay describing the activities.

Hospitality. The hospitality committee provided "greeters" at the high school door and posted numerous signs informing teachers where to go to find what they wanted. This group also arranged for the PTA to serve coffee and doughnuts for 15 cents prior to the meeting. Proceeds of about $100 went to the Child Welfare Fund.

Registration. Everyone was urged to register; there was no charge for the occasion. Membership in the Association (50 cents a year) was strictly optional. The organization was such that no one had to wait in line to register or to pay dues. Programs, school maps, and announcements were distributed at the registration desk. Lapel name cards were provided by the Richmond Chamber of Commerce.

Program. As the feature attraction of the meeting, the program committee sought Dr. Earl S. Herald, marine biologist at the California Academy of Science in San Francisco, and principal personality in a very popular weekly half-hour television program. Dr. Herald spoke on the purposes of the "Science in Action" TV show, and the problems involved in preparing the weekly program. Among his principal attractions were the several animals which he brought along to illustrate his points. The speaker's honorarium was paid by the sponsors of his television program—The American Trust Company of San Francisco.

Luncheon. This was served by professional caterers—an excellent steak dinner for $1.50 per plate. There were 290 luncheon reservations, but inclement weather forced the number of persons eating down to about 240. The unused steaks were quickly sold at cost, and the Association paid the remaining difference from its treasury.

Making luncheon reservations for a function of this kind is a most distressing problem. Experience has shown an almost complete lack of relationship between advance reservation and actual sale of tickets. It is probably better to turn people away than to have to make up financial deficits. An inexpensive and informal lunch—not too heavy—and a very short program or business meeting are conducive to good attendance.

School Exhibits. This committee was sub-divided into two groups, one to operate within Richmond proper, the other in surrounding areas. Although a few displays were set up by nearby teacher-education institutions and by junior museums, most of them were the actual work of elementary classes of the Bay Area. In many cases, grade school students were on hand to discuss their exhibits. This is invariably an attractive and worth-while feature. Some of the materials on display were prepared subsequent to the September opening of school. But most of them were intentionally held over from the previous spring term. Without long-range planning such foresighted preparation would have been impossible. In all, nearly twenty high school classrooms were filled with exhibits from school districts of nine cities, three counties, and two state colleges. Most of these exhibits and room arrangements were set up on Friday, October 9, after high school students were dismissed. Some were set up the morning of October 10, before the time scheduled for the general session.

Demonstration Teaching. One of the feature activities of this meeting was the series of demonstration lessons scheduled during the early afternoon at a nearby elementary school. These were conducted by Richmond classroom teachers, each with about twenty of his own students.

Children participating in classroom situations were observed and given an opportunity to explain what they were doing and how it applied to their everyday living experiences.

Industrial Displays. Advance planning made it possible to secure the services of industries for appropriate presentations. Eight displays and talking demonstrations were exhibited. Many others hearing of the project asked to exhibit, but had to be refused because of limitation in floor space and time.

Commercial Exhibits. Representatives of commercial products are usually delighted at the chance to display their wares at a gathering of this kind. For this occasion, these opportunities were limited to suppliers of science books and science equipment. Nine such organizations were permitted to set up booths in prominent places in the halls.

This intensive pattern of committee work would have been relatively ineffective but for the hearty endorsement by the school administrators of the entire project. In general, principals and supervisors took the same attitude about the approximately 200 teachers involved in lesser roles of putting on the entire affair. Everyone was working—superintendents, principals, supervisors, pupils, parents, and businessmen. School buses and trucks were scheduled to move the necessary tables and equipment. Needed school supplies were given unstintingly. Personnel services were offered. A program such as this could never have materialized had not the superintendents and other school administrators given full cooperation.

Outcomes of the Project

There are many ways to judge the outcomes of an enterprise such as this Richmond meeting of the Elementary School Science Association. The Association itself had a successful meeting, collected a respectable sum in membership dues, and in general continued to serve the interests of elementary school science in the San Francisco Bay Area. Both the Association and the Richmond Public Schools received excellent publicity. Total atendance was 827.

But there is another measure of the effects of this project. It is highly subjective, and difficult to express in meaningful quantitative terms. And yet of all the available forms of evaluation, it is the most meaningful and the most worth while. This is the observable change in attitude and behavior on the part of citizens, teachers, and students who were involved.

The teachers who feared the doing and being of this program were delighted with the recognition they and their pupils received. The science activities of the classrooms have taken a definite upsurge in the school districts involved. Teachers are centering on science activities to develop and maintain a wide range of active interests which the child or class can investigate. They realize that at the elementary level there is the greatest opportunity for the teacher and pupils to work, experiment, and learn together.

Richmond Superintendent of Schools, George D. Miner, summed it up this way:

"I am delighted with the outcomes of the Elementary School Science Association meeting held here last October. It was one of the finest examples of cooperative planning and execution I have ever seen."

"Our whole staff of administrators and teachers has learned to work together more closely and more effectively. The enterprise brought us excellent public relations with parents and with the community as a whole. But perhaps most important of all, the project has produced immediate and lasting results in terms of the ways in which our teachers and students are handling science in their classrooms."

EVIDENCE AWARENESS

By B. CLIFFORD HENDRICKS

Longview, Washington

"AWARENESS . . . keeps a good newspaper on its toes," says a recent editorial in our *Daily News*. This is "news awareness." It is but another way of saying, "A good reporter has a nose for news."

In a similar vein there is warrant in saying that there is "evidence awareness." Such evidence sensitivity is presumably one of the marked assets of a well trained scientist. He is ever "in tune" for the pertinent in his field of interest.

The present concern, however, is not for the conditioned scientist. It is for the commoner, John Doe, as he seeks to find his place and make his contribution in a world of multiplying gadgets and attention dissipaters. What follows is presuming that even high school boys and girls may be somewhat immunized against the role of puppets under the spell of dogmatic commentators and plausible, smooth-tongued salesmen. It is further assumed, in this emphasis of "evidence awareness," that evidence sensitivity is to be serviced by skill in the choice and tie-in after the evidence is in hand.

The major attention here is directed to the questions: Can this trait be made habitual by proper teacher planning? Can the program for the young people of his classes be so ordered that they come to "feel" for evidence without conscious effort?

Pertinence of Evidence

"In the history of science . . . evidence has loomed large in the narrative." [1] It can be shown to enter into our daily affairs in many and intimate ways. While its successful use is often dependent upon the skill of others in gathering it for us, we need not be wholly at the mercy of the experts in that regard. Heiss, Obourn, and Hoffman [2] accentuate the need when they say, "Living in a modern world where emotional thinking and appeal are rampant makes it imperative that young people *learn* what the earmarks of good evidence are. It is feasible to *show* then how evidence is regarded by the scientist." Following these statements these authors devote half a hundred pages to "show" that young people may "learn" what good evidence is.

But do "showing" and "learning" eventuate in *awareness?* It has been said, "A fact or principle has been fully learned when the student uses it spontaneously in his daily affairs." [3] That is fully learned which finds habitual expression.

Hazard of Implicit Reporting

A recent college textbook in chemistry [4] promises "a readable book that gives some idea of the historical background of science; an understanding of its principal ideas and some conception of the methods . . . of industry." It does not promise any concern for the manner in which the facts, ideas, and methods of industry emerged from "good evidence." A brilliant student can read this skillful writer's presentation without becoming aware of science's major contribution to his "sensitivity to evidence." For some of us, this is a regrettable omission.

There are books, however, which consistently use explicit diction; i. e., they make the reader "aware" of the evidence that backs the prediction of generalization. Weaver and Foster [5] have many statements such as "He secured facts (evidence) to support his reasoning"; or, "The larger volumed gas (from electrolysis of water) catches fire when lighted by a match. This will serve . . . as a test (evidence) for hydrogen." Hatcher [6] in his introductory college chemistry textbook repeatedly formulates his exposition in explicit terms and by so doing, shares with the reader the evidence back of the statement. The following passage, picked at random, illustrates the point. "What has been said above (evidence) about vapor pressure . . . applies to all liquids . . . In the tests above (evidence) three nonmetals burned . . . to give oxides . . . By exposing (air) . . . to lumps of calcium chloride (evidence) . . . (it) may be demonstrated . . . that the atmosphere contains some moisture at all times."

Krauskopf,[7] in a somewhat different form, accen-

[1] Hendricks, B. Clifford. "Laboratory Evidence"; *The Science Teacher*. XX:170-171, Sept., 1953.

[2] Heiss, E. D. and others. *Modern Science Teaching*. Macmillan Company, 1950. New York. **Page 158.**

[3] Morrison, Henry C. *Practice of Teaching in Secondary Schools*. University of Chicago Press, 1926.

[4] Since there are many others with this defect, this author's name is withheld.

[5] Weaver, E. C. and Foster, L. S. *Chemistry for Our Times*. McGraw-Hill Book Company, 1947. New York.

[6] Hatcher, W. H. *Introduction to Chemical Science*. John Wiley & Sons, 1949. New York.

[7] Krauskopf, Konrad. *Physical Science*. McGraw-Hill Book Company, 1953. New York.

tuates the role of evidence in the choice of postulates for explaining natural occurrences. "The work (evidence) of Tycho Brahe and Kepler . . . (gave) one hypothesis (that of Copernicus) a great advantage over the others (Ptolomey's) . . . Kepler . . . (by his observations) did not prove that Ptolomey's picture of the universe could not be made to work . . . but only that . . . (that) proposed by Copernicus made . . . (it) simpler." In tracing the beginnings of the kinetic theory this author says, "Physicists . . . tried to show that the familiar characteristics of matter (observable evidence) follow from an application of ordinary physical laws to particles with . . . assumed peculiarities. This attempt was . . . successful . . . Furthermore, use of the assumptions (kinetic theory) enabled . . . (a prediction) of unsuspected quirks in the behavior of matter . . . Their agreement with observed facts (evidence) justifies their acceptance as true statements."

Authors who skillfully and pointedly relate their statements to the objective evidence from which they evolve are fewer than 100 per cent. So the teachers who wish their textbooks to contribute to habitual "evidence awareness" need to make a rather critical inventory of the book they plan to use.

Awareness by Observation

"Learning about" and "showing how" evidence is obtained may not produce habitual "evidence awareness." Here, learning by passive indirection is as likely to be disappointing as to assume that good character may be expected of the individual who memorizes the moral code. It is not more probable that if getting evidence is made a conscious aim in all experimental activities; if the learner learns "by" instead of "about"; if he "does" rather than is "shown"—that the practice entailed may presently lead to habitual self-directed groping for basic facts (evidence)? Is it possible that one who has been so conditioned may come to have a sense of "let-down-ness" if an experiment or demonstration fails to reveal those tangible, often measurable, outcomes?

In one demonstration an incandescent burning magnesium ribbon was lowered into a bottle of carbon dioxide. With what result? It continued to burn; i.e., remained incandescent. Its shiny metal surface became a white powder very like that produced when it burned in air. But there were black specks mixed in with the white powder. Thus there were three bits of evidence. The explanation is built upon that evidence. Of course the failure of the expected "put out" of the ribbon's flare by the fire-extinguishing gas, carbon dioxide, could be accounted for by the teacher without reference to the two sorts of powders. Many times the "I am telling you" report ignores the evidence—whether it comes over the radio or after the lecture demonstration.

Master teachers of science are frequently remembered for their skill in helping the laboratory learner to *feel* as well as *learn* that evidence often has the final say. Dr. Steiglitz was making his tour of the analytical laboratory one afternoon. He found a student with a flask of liquid boiling vigorously over the burner. "To what purpose are you heating that liquid?" was his question. "I am concentrating some ammonia solution," was the reply. "The directions called for concentrated solution. I could not find it on the shelves." "I shall be interested in your results," was the parting remark. That experienced teacher expected the evidence from the residue (?) in the flask to be a more forceful bit of evidence than any words he might offer.

Louis Agassiz left his impress upon his students by expecting them to become aware of evidence, often by "the hard way." William James, writing in *The Scientific Monthly* (p. 350, 1947), said: "There is probably no teacher (who has trained under Agassiz) who (would) not tell you how Agassiz used to lock a student up in a room full of turtle shells, lobster shells, or oyster shells, without a book or a word to help out, till he discovered all the truths which the objects contained." He who "dug his way out" of such imprisonment would surely attain high regard for one of the tools, of his "dig out" from that intimate association with shells; i.e., evidence awareness.

He Loses Unless He Uses

Perhaps the quickest way to tell a textbook from a "club book" is by taking a hasty glance at the exercises at the end of the chapters. The presump-

Thought-provoking and solid is the way we rated this article after reading it in manuscript. Even so, we thought, there are practical situations in which the *application* of the author's plea for "turning to the evidence" must be tempered and adjusted with skill and understanding. For example, many students we've worked with would hardly profit, in our opinion, by being locked up in a room with lobster shells or dead perch ala Agassiz. We'd like to have your opinions and reactions after you have read the article. Would you agree with us that the author should proceed with dispatch in conducting a session on "evaluation of evidence"?

tion is that exercises aid in the classroom practice-use of the chapter's content. They are a help in getting the book's reader to apply and rehearse what he has read. Such exercises are quite often divided into memory questions and thought questions. A third category is here suggested: evidence-evoking questions. Do the following summon the testimony of evidence in their answers?

> How would the fall of a stone at the North pole differ from its fall at the earth's equator? For what is this difference a supporting evidence?
>
> How do observers know when a meteor strikes the earth's atmosphere?
>
> A test tube of hydrogen burns explosively; for what is this an item of evidence?
>
> What was the evidence that led to the rejection of the phlogiston theory?
>
> How test whether a solution is acidic, basic, or neither?
>
> How is it known that the earth's atmosphere extends upward for 750 miles?
>
> How are uranium and lead content used to estimate the age of a rock formation?

A census of textbooks of science reveals slim regard for this sort of awareness. Science has been said to be the midwife for explicit thought. But explicit thought is, in turn, the product of evidence-backed judgments. The foregoing evidence-evoking questions were assembled only after diligent search among textbooks. There were many exercises of the memory type and a considerable sampling of the thought type. There was a distressing monotony of questions or statements that began with: *list, point out, state, what is, write an essay, name, define, name examples, complete, suggest, how many, trace, enumerate,* and so on. The teacher expecting help for his desire to minister to evidence awareness through evidence-evoking questions will need to take a second look at the book he is using. He should make sure it contributes to the practice of evidence finding and using.

Social workers and law students make much use of the "case study" technique. Dental and medical colleges have their clinics. In all these areas the stress is on practice with the reality the trainees expect to face after their training is over. Information is important, but its degree of importance is limited by the method of its use. Informed scientists? Yes. But each will perform in a changing, natural, and artificial set-up toward which he must be sensitive. For basic to his action is certainty of the *evidence* for the plan of action. Awareness keeps a good scientist sensitive to his evidence. It

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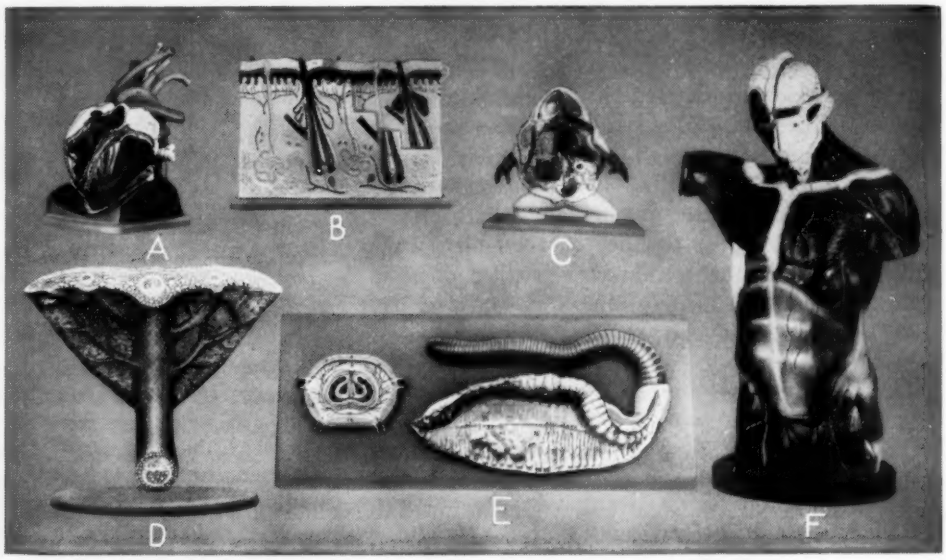

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also helps John Doe to know that he is alive and that "aliveness" is worth keeping. Evidence-warranted conduct is not associated with puppets. The "aliveness" of puppets is open to question.

Evidence "Bewareness"

It has been said previously that "Evidence . . . (needs) to be serviced by skill in (its) choice and tie-in . . . after it is in hand." It is to be remembered that Heiss and his co-authors were commenting on "good evidence." A defense attorney needs to be alert both to the good evidence for his client and careful to guard against, beware of, spurious offerings of his opponent. All of which seems to suggest there ought to be a session on "evidence evaluation."

Test Tubes and Tadpoles for Teachers of Science

By IRA E. SHEIN

Chairman of Science Department, Benjamin Franklin Junior High School, New York City

FROG'S EGGS, tadpoles and thyroxin; snails, tropical fish, anacharis and test tubes; even science teachers would consider these strange food. Yet, food it is. Food for thought: "food" for the development of the ability to understand science and the scientific method. By observing and learning from his own observations and evaluating them on the basis of what is known, a student learns to think for himself. The students who sit in our science classes today will be the citizens of tomorrow. Some of them will become scientists; they must help push forward our intellectual frontiers. The others will be the "plain" citizens who must be able to understand the advances of science, help support the research, and direct it towards a better life for all. Our increasingly highly industrialized society demands such people. The science teaching program plays a vital role in their development. Proper teaching materials are essential for such a program. The effectiveness of instruction may hinge upon the materials available and their effective use. Here is the challenge for the administrators of science education (and the citizens who pay the bills).

A number of studies reported by Hubler show that lack of equipment and supplies are among the most important problems faced by teachers in effective science teaching. Personal experience of the writer and many of his colleagues confirms these findings.

Hildreth *(Child Growth Through Education)* tells us that science appeals to children from all levels of ability when concrete materials are used. Slow learners in the writer's classes have borne this out repeatedly. Bright pupils, too, showed more interest when concrete materials were used. Professional books and state syllabi all recommend the use of concrete experiences in teaching science. Experience is basic to learning. Materials for such experiences should be available in all schools. Available means *present,* but it also means *easily obtained when needed.* The problems in the administration of science teaching materials, therefore, are: selection of materials; purchase of supplies; and management and use of equipment.

Planning

As in any sound business or educational enterprise, planning is the first step. The objectives set up for a course should determine the type of materials needed. Courses based on studies of environmental areas may require different equipment than those based on children's problems. In any event, facilities should be provided for individual laboratory work and for teachers' and students' demonstrations. The furnishing and arrangement of the room are probably the most important considerations in vitalized science teaching. Many authorities recommend that the planning of a science room should be a cooperative project of the engineer and architect with the science teacher and educational supervisor. How important the room arrangement is will be readily acknowledged by anyone who has experienced the difficulty of trying to have students do committee or individual experimental work in rooms with fixed seats providing little aisle space and no convenient work surface. Electricity, gas and water are also important.

A little ingenuity can go a long way in improving existing facilities. Work tables can be constructed by students. Electricity can be drawn from the light sockets. Empty five gallon drums make water reservoirs. Heat is still hot if alcohol burners or electric hot plates are used instead of gas burners, even though the latter are more convenient. Such improvisation is important, since most science teaching today is done in rooms not designed for the study of science.

Equipment

Expensive laboratory equipment is not always needed in teaching science. Teachers may be more at home with the specialized materials they used in their college science courses, but students will feel more at home with materials that are familiar to them. A pyrex baby bottle makes a demonstration a little more real to a student than an Erlenmeyer flask. Besides, the bottle has possibilities for home experimentation. Children can often benefit by constructing substitutes. Such replacements for expensive equipment may actually be better for instructional purposes. They are certainly useful where there is a limited budget. Still certain supplies must be planned for. Equipment money is best spent on more permanent things (i.e. microscopes, scales, storage batteries). Other equipment cannot be neglected. Chemicals, glass and rubber tubing, magnets, compasses, cork and rubber stoppers and test tubes are a few of the small items which should be obtained for all good science teaching. Adequate equipment for work by the pupils should be available; even duplicate sets of equipment may be needed where students are to do the same exercises at the same time. Teachers and pupils should provide as much specimen material as possible in biology courses, but money should be available for the purchase of live materials, animals and spoilable items. Visual aids of various types should also be available, but they should not supplant nor duplicate things that can otherwise be shown in class. These are educational fundamentals of administrators.

The living-learning situation in the classroom is the basis of education. The chief desire of the administration should be to provide the materials to enrich this situation. Practices and equipment of other good schools should guide the administrator in making the final selections. Which of the recommended materials ought to be purchased will be determined by the following criteria:

(1) Is the material economical?
(2) Is it usable in the available space?
(3) Can other already available materials be substituted for it?
(4) Can the manufacturer provide the desired services?

These criteria must be flexible. Occasions will arise when it will be desirable to buy equipment which does not meet all these requirements. Actual purchase should be under the jurisdiction of the Board of Education, but should be done by a specially designated person with the advice of the department heads in science.

Economy-minded officials can be very skeptical. The science chairman must be prepared to explain how the expenditures make a significant difference in the teaching program. After each school decides upon its needs, the central administration should make available: the administrative machinery for study of these requests; all up-to-date information on the quality of materials available; and funds to buy adequate amounts of equipment.

Procurement

There are remedies for the annual headaches of purchasing. A tight budget can be stretched to fit the demands of the teachers and students more easily and economically when the purchasing is centrally done. Under such a plan, all requests are channeled through a central purchasing agent who then does the actual ordering. It is his job to see to it that sound business and educational practices are employed: purchases should be made to take advantage of slack time; competitive closed bids should be entered for all merchandise; and price should be secondary to quality and the use to which the material is to be put. The purchasing agent will have to rely on the science chairman for advice. The kind and quality of the material must be justifiable from the point of view of improving instruction. Under such a plan, a standardized list of supplies and equipment available would be prepared with the assistance of someone with classroom administrative experience. Specifications should be as simple as possible, yet have the needed minimum details. Consultation with the teachers and examination of a running inventory would then permit the chairman to order those supplies which would be most useful. An accurate, simple inventory system may be set up on cards to show the location, condition, and number of pieces of all science equipment in the school. New equipment should be entered immediately upon arrival, and consumption and breakage duly recorded. This system should be supplemented by an annual inventory and a "want book" in which all requests are entered as they arise during the year. Ideally, such record keeping should be the responsibility of a laboratory assistant or teacher who is provided with time for this duty.

Schools in smaller communities would have to purchase directly rather than centrally. Here the science chairman would have to be aware of all the sources of supply available and the business practices involved in ordering. In such communities, he might well give consideration to local purchasing where there is no price differential and comparable services are offered. Such a plan helps improve relations with the community, avoids delay in get-

ting supplies, and frequently provides materials which make for more significant relationships for the pupils because of greater familiarity with the product. Baking soda is more meaningful than sodium bicarbonate to most pupils. Other than local purchases should be made where economy and efficiency demand it.

All schools can benefit from having a cash account for small local purchases. Unanticipated demands are bound to come up, particularly where creative activity by the children is under way.

Utilization

Famous last words—"I know we have that somewhere." Unavailable or mislaid equipment is useless. A central storage room for all supplies is best for providing convenient access and distribution of supplies. If possible, this should be adjacent to the science rooms. All science rooms should be provided with such materials as test tubes, bunsen burners, and small bottles of reagents and chemicals which are frequently used in connection with the study of many topics. Other items should be stored centrally according to a carefully prepared plan. Small items might be stored in labelled drawers alphabetically arranged. Other materials might be stored under a scheme of classification according to the use to which they are most likely to be put.

Dry cells, compasses, magnets, and wire could be stored together for the study of electricity and magnetism. The topic of sound and light might include other items. All chemicals should be stored together in a metal cabinet. Glass items would be kept in one place. Preserved specimens of living things can be set up in a museum-like display if space is available. Other items from which learning might take place without manipulating them could also be placed in display type cabinets. Present space should be used effectively and additional storage facilities created where needed. Easily constructed open shelves can serve where nothing better is available. A work table and sources for electricity, gas and water are a valuable addition to any such room.

Where a laboratory assistant is present, material can be readily available on order by the teachers. In less fortunate schools, the teachers would have to anticipate their needs and take the equipment to their rooms at the proper times. It should be returned to place when it is no longer in use. The cooperation of all teachers should be enlisted, but it is advisable for one person to be provided with time to check on maintenance of order. This is also a long-run economy measure. A well-trained squad of students can be a big help in maintaining order and providing ready access to materials. Time spent in training such a squad will be amply repaid, and the pupils will, likewise, benefit.

Many science departments are troubled with items that have not been returned to their assigned places. This is particularly true where there is no laboratory assistant. A system to remedy this involves assignment to each science teacher of a box of tags of a different color. When an item is removed by a teacher, his tag is placed on the hook permanently fastened at the assigned place for that piece of equipment. The tag is removed when the item is returned. Tracing items becomes a simple task.

Teaching kits, which start where the textbooks end, are very valuable to teachers and provide materials not always easily assembled by the teacher. They might include any or all of the following: (1) pictorial and descriptive materials on specific topics; (2) bulletins of suggestions; (3) specimens; (4) science bulletins on various reading levels; (5) source units; and (6) visual aids. Such kits can be permanently packed in boxes. Ordered as a unit, they can be circulated within a school or school system. The work would have to be so planned that no two groups would use the kit at the same time. Teachers are always asking for more and better materials for themselves and their students. Here is a concrete plan to provide it.

Civilization has been defined as a race between education and catastrophe. Administrators (and teachers) must improve the odds for education over catastrophe. Science can lead to catastrophe or better living for all. Science education, then is doubly important for the future of civilization. Good and plentiful science teaching materials are not the science program; but they do contribute to the understanding being developed by that program. A science administrator must see to it that the materials are available when, where, and as needed.

FISK TEACHERS AGENCY
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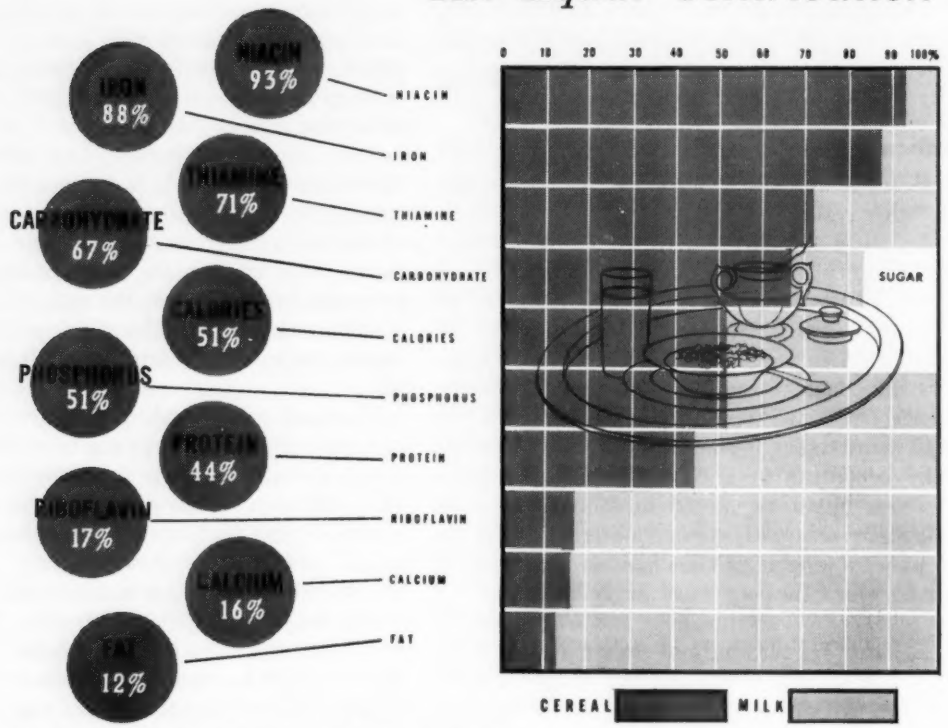
Teachers in the different fields of Science have exceptional opportunities through our office for positions in high schools, colleges and universities. *OUR SERVICE IS NATION-WIDE.*

CEREAL AND MILK MAKE

An Equal Contribution



That breakfast cereals make a significant contribution to the overall nutrient content of the cereal and milk serving consisting of 1 oz. of breakfast cereal, 4 oz. of milk, and 1 teaspoonful of sugar, is readily apparent from the bar chart. In the case of five of the nine nutrients common to both, as well as in calories, the breakfast cereal alone provides more than 50 per cent of the total amounts contributed by both cereal and milk, and almost 50 per cent of the protein.*

The values shown demonstrate that breakfast cereals are significant sources of many essential nutrients. Their inclusion in the balanced breakfast goes far in satisfying the daily requirements of the nutrients they contribute. For this reason they are widely recommended by nutritionists as an important component of a basic cereal breakfast consisting of fruit, cereal, milk, bread and butter.

As a service to teachers and their students and as a result of twelve years of research, Cereal Institute offers free authoritative and coordinated cereal and milk and breakfast teaching materials. Write for yours today!

***These figures are based on composite averages of all breakfast cereals —whole grain, enriched, or restored to whole grain values of thiamine, niacin and iron.**

Cereal and Milk Festival No. 2

The program of long range cooperation between the American Dairy Association and the Cereal Institute announced over a year ago goes into its second year with the endorsement and support of both industries.

In 1955 the event is known as

"Spring Cereal and Milk Festival"

and will be launched the middle of April. In the average year 2½ *Billion Quarts of Milk* are eaten with breakfast cereals.

You never outgrow your need for Cereal and Milk.

CEREAL INSTITUTE, Inc., 135 South La Salle Street, Chicago 3, Illinois

A research and educational endeavor devoted to the betterment of national nutrition

New Requirements for

By CONRAD E. RONNEBERG

Department of Chemistry, Denison University
Granville, Ohio

PRESENT CONCERN over the nature of the education of prospective high school science teachers is both widespread and deep. New requirements for the certification of science teachers have recently been recommended and adopted in Ohio. Developed by a large and representative committee, it is believed that the new standards represent an improvement over former requirements. It is hoped that this report of how the new requirements were developed and what they are will be helpful to persons and groups who may be engaged in similar studies.

Background

Certification requirements in Ohio were last changed in 1939. These specified a minimum of 17-18 semester hours in Professional Education, a minimum of 15 hours in one science subject, and a minimum of 40 hours in all science.

A committee to review these requirements was established as a sub-committee of the Advisory Council on Teacher Education and Certification of the Ohio College Association. Personnel of the committee was augmented by many persons interested in science such as representatives of various professional teacher groups, teachers of science, representatives of professional societies, school administrators, representatives of science-based industries, and others. (See listing at end of article.)

Committee work started in July, 1954. It culminated in recommendations covering science teaching certificates in November. New recommendations were adopted at a public hearing on December 15, 1954.

Bases for Recommendations

A. The committee adopted as a guide for a desirable pattern of training of teachers, the recommendations of the Commission on Teacher Education, American Council on Education:[1]

General Education: $\frac{3}{8}$ of the college program—about 45 semester hours

Professional Education: $\frac{1}{8}$ to $\frac{1}{6}$ of the program—from 15 to 20 semester hours

Subject Preparation in Teaching Fields: $\frac{4}{8}$ of the program—60 semester hours

At present, the requirement in Ohio for Professional Education is 17 semester hours. The committee felt that this should not be increased. To raise requirements in this area at the expense of general education and training in teaching fields would not be wise.

At present, 45 semester hours are recommended as a reasonable allocation to General Education. The committee agreed that prospective science teachers should be required to have 45 semester hours in General Education together with 8 semester hours in fundamental mathematics.

The committee agreed that prospective science teachers:

(1) have as broad training as possible in related science fields (great depth cannot be expected);
(2) be prepared to teach two or more sciences;
(3) be prepared to teach general science;
(4) be ready to teach integrated science courses when given;
(5) have training in chemistry, physics, and biology; and
(6) have rather a wide choice of elective science courses or options to qualify for the science certificate.

[1] *The Improvement of Teacher Education.* Final report by the Commission on Teacher Education, American Council on Education, Washington, D. C.; 1946: 112-117.

The committee felt that certification to teach science should eventually be made only on the basis of a Comprehensive Major in Science.

B. The committee believed that an increase in the requirements for General Education and for subject matter training should eventually (1) improve the quality of science teaching, and (2) attract capable young persons to the teaching profession.

Final Authorized Requirements

Committee recommendations adopted at the public hearing on December 15 took the following form:

A. Professional Education—17 semester hours

B. General Education

(1) 30 semester hours minimum with a formula for distribution; and

(2) a recommendation of 45 semester hours in General Education.

C. Science (Comprehensive Major)—45 semester hours

(1) Physics, chemistry, and biology—36 semester hours
This should be distributed to provide: 20 hours minimum in one field; 8 hours minimum in a second field; 8 hours minimum in the third field.

(2) Additional courses in science—9 semester hours
This should be in such fields as astronomy, biology, chemistry, geology, meteorology, physics, and physiography, or in mathematics in advance of mathematics offered to meet General Education requirements.

The formula above allows for considerable choice on the part of the student, which is very desirable, and should provide for a major field, a reasonably strong teaching minor, and some training in related fields. Typical possible patterns might be:

I

Biology	20 hours
Physics	8 hours
Chemistry	8 hours
Elective physics	6 hours
Geology	3 hours
TOTAL	45 hours

II

Chemistry	20 hours
Biology	8 hours
Physics	8 hours
Elective physics	9 hours
TOTAL	45 hours

D. The committee feels that a person qualifying with the above program would be better prepared to teach two sciences and general science than a person who meets the former minimum requirements.

E. In the interim period 1956-60, certification must proceed in the former limited areas. Minimum requirements in teaching fields are:

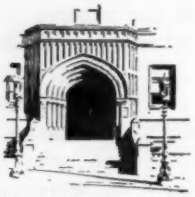
(2) Biological Science (no change)—15 semester hours—basic courses

(5) Earth Science (no change)—15 semester hours—including appropriate courses in geology and geography.

(7) General Science (an increase from 18)—21 semester hours—including basic courses in physics, chemistry, and biology, botany, and zoology.

(17) Physical Science (an increase from 15)—21 semester hours—basic courses in both physics and chemistry.

The Department of the Teaching of Science



TEACHERS COLLEGE
COLUMBIA UNIVERSITY

REQUESTS APPLICATIONS for du Pont Summer Fellowships for science teachers who desire an opportunity to study the newer developments in the physical sciences and their significance for the high school science program.

The Fellowship covers six points tuition and a substantial allowance for personal expenses.

The Summer Fellowship study program will include lectures, demonstrations, field trips, laboratory experiences, preparation of teaching materials and group discussions. The staff will consist of faculty members from academic departments of the University and from the Department of the Teaching of Science.

For further information and application blanks write:

MISS MARIE STOLL
Department of the Teaching of Science
Teachers College
Columbia University
New York 27, New York

Goals Ahead

Our committee was unsuccessful in getting a specific requirement of 8 semester hours of college mathematics.

We were unsuccessful in getting consideration for new requirements for the permanent certificate. The committee urged that the permanent certificate be granted upon the completion of the required teaching experience and of a year of advance study which should total at least 30 semester hours and should be distributed as follows:

In subject matter teaching fields—at least 50 per cent

In professional education courses—at least 25 per cent

Electives—remaining hours

The committee hopes that the State Department of Education will again start consideration of the problem not later than early January, 1956.

We were unsuccessful in getting a commitment calling for certification in a Comprehensive Major or in General Science only after 1960. This question must be raised again after several years' operation of the new program.

Encouragement

The committee was greatly encouraged by the growing recognition of the need for greater emphasis on subject matter training in teaching fields, including science. We were pleased with acceptance of the principle that raising certification standards will not by itself adversely affect the future supply of teachers. There is reason to believe that the effect will be just the opposite.

Great encouragement is to be found in the diverse membership of the committee and in the nature and large number of participating groups and organizations. It was a personal privilege and pleasure to serve as chairman for such an enthusiastic and sincere group.

Committee

A. Appointed by Ohio College Association

CONRAD E. RONNEBERG, *Chairman*, Department of Chemistry, Denison University, Granville

E. T. BODENBERG, Department of Zoology, Wittenberg College, Springfield

A. S. KIEFER, Science Teacher, North High School, Columbus

W. M. PIERCE, Department of Physics, Ohio University, Athens

GLENN A. RICH, State Department of Education, Columbus

C. H. WILLIAMS, Superintendent of Schools, Butler County, Hamilton

B. Groups and organizations whose representatives augmented the committee personnel

American Chemical Society

American Physical Society

Chemistry Section of Ohio Academy of Science

Division of Chemical Education, American Chemical Society

Junior Academy of Ohio Academy of Science

National Science Teachers Association

Northeastern Ohio Chemistry Teachers Association

Northwestern Ohio Chemistry Teachers Association

Ohio Academy of Science

Ohio Science Education Association

Zoology Section of Ohio Academy of Science

C. Industrial firms represented on the committee

Diamond Alkali Company

B. F. Goodrich Company

Hilton-Davis Company

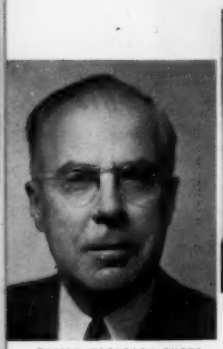
What Is It?

Scientists in countries all over the world have spent 125 years in an attempt to duplicate nature's hardest and most glamorous crystals. Shown above is the largest artificial diamond yet made at the General Electric Research Laboratory (1/16th in. in longest dimension). It is photographed beside a standard, diamond, high-fidelity phonograph needle to indicate its relative size.

HIGHLIGHTS of the NSTA 1955 NATIONAL CONVENTION

GEORGE W. BEADLE, California Institute of Technology, Pasadena. Chairman, Division of Biology; President of the American Association for the Advancement of Science; will speak on "The Structure and Function of Genes" at general session, Thursday evening, March 24.

JOHN ENGSTEAD PHOTO

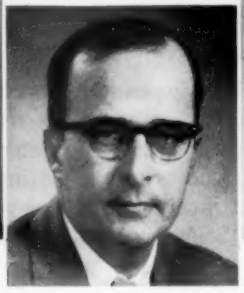


WALTER S. LAPP, Overbrook High School, Philadelphia. President of NSTA; will preside at afternoon and evening general sessions, Thursday, March 24; will participate in symposium on "Turf Grass is Conservation," Friday afternoon, March 25.

SWEENEY & SHISLER PHOTO

ROBERT STOLLBERG, San Francisco State College, California. President-elect of NSTA; will preside at general session, Saturday morning, March 26.

THE STAGGS



FABIAN BACHRACH PHOTO

GERALD S. CRAIG, Teachers College, Columbia University, New York City. Professor of the Teaching of Natural Sciences; author of numerous books and articles on teaching elementary science; will speak at elementary science symposium, Thursday afternoon, March 24: "More Realistic Science Teaching Toward What Ends in the Elementary Schools."

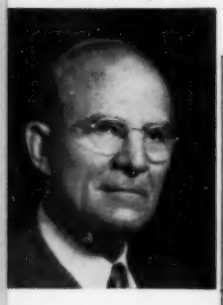
BLACKSTONE STUDIOS

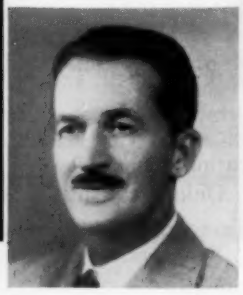
HUBERT M. EVANS, Teachers College, Columbia University, New York City. Professor of the Teaching of Natural Sciences; will chair symposium on "The Impact of Research on the Teaching of Science: What Have We Learned? What Do We Need to Find Out?", Thursday afternoon, March 24.

LARRY G. COONEY, Pittsburgh Plate Glass Company, Pennsylvania. Chairman of NSTA Business-Industry Section; will preside at business meeting of the Section, Thursday morning and at symposium on "Things You Want to Know About Free Teaching Aids," Thursday afternoon, March 24; in charge of "Hospitality Night," Thursday evening, sponsored by B-I Section in cooperation with Cincinnati business-industries.

ROBERT R. WILLIAMS, Research Corporation, New York City. Will give banquet address Friday evening, March 25: "Science and Social Thinking." Director of chemical research, Bell Telephone Laboratories, 1925-45; assistant to President of Research Corporation since 1950. Determined structure of and synthesized the antineuritic vitamin, B_1.

CONWAY STUDIOS, INC.



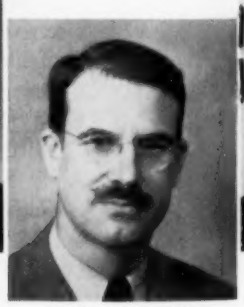


KENNETH E. VORDENBERG, Supervisor of High School Science, Cincinnati Public Schools. General chairman of local committees and arrangements; will preside at session on "Homes For Today," one of the concurrent Reports of Research in Science and Their Implications for Science Teaching, Friday afternoon, March 25.

UNIVERSITY OF CINCINNATI PHOTO

RALPH W. McDONALD, President, Bowling Green State University, Ohio. Will deliver convention keynote address, Thursday afternoon, March 24, speaking on "Facing the Facts in American Education." First Executive Secretary, Association for Higher Education (NEA); member of Educational Policies Commission since 1951.

BOWLING GREEN STATE UNIVERSITY NEWS BUREAU



VAN DYKE STUDIO

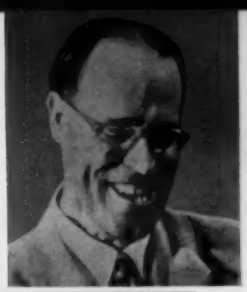
FRED V. GRAU, Agronomist, West Point Lawn Products Corporation, West Point, Pennsylvania. Will discuss "Turf Grass is Conservation" as one of concurrent Reports on Research in Science and Their Implications for Teaching, Friday Afternoon, March 25.

CECILIA E. UNZICKER, Supervisor, Intermediate Grades, Cincinnati Public Schools. Chairman of discussion group on "More Realistic Supervisory Aid for the Improvement of Instruction in Elementary Science."

ROBERT J. HAVIGHURST, University of Chicago. Professor of Education and Chairman of Committee on Human Development; will address general session, Friday morning, March 25, speaking on "Science and Intelligent Choice."

J. M. KENDALL, Aerophysics Division, Naval Ordnance Laboratory, White Oak, Maryland. Will discuss recent advances in aviation as one of the concurrent Reports on Research in Science and Their Implications for Science Teaching, Friday afternoon, March 25.

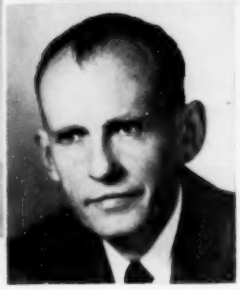
NAVAL ORDNANCE LABORATORY



HUBERT N. ALYEA, Princeton University, New Jersey. Professor of chemistry; will present "Simple Chemistry Demonstration You Can Do" at the general session, Saturday morning, March 26.

STANLEY E. WILLIAMSON, Oregon State College, Corvallis. Will lead discussion group on "Planning Toward a Consultant or Supervisor for Science in Each State Department of Education," Friday, March 25.

BONNIE C. HOWARD, Supervisor, Upper Elementary Grades, Louisville Public Schools, Kentucky. In charge of elementary science portions of convention program; will chair "Here's How I Do It" session in elementary science, Saturday afternoon, March 26.



J. DONALD HENDERSON, University of North Dakota, Grand Forks. Will chair clinic session on "More Realistic Science Teaching in the Small High School," Saturday morning, March 26.

LEE EVANSON STUDIO

IRENE HOLLENBECK, Southern Oregon College, Ashland. Will serve as chairman of the "Here's How I Do It" session in biology, Saturday afternoon, March 26.

JESTEN-MILLER STUDIO

ALFRED B. GARRETT, Ohio State University, Columbus. Professor of Chemistry, radiological defense coordinator for the state of Ohio; will discuss recent development in research with radioisotopes as one of the concurrent Reports on Research in Science and Their Implications for Teaching, Friday afternoon, March 25.

ROSE LAMMEL, New York University. Professor of Education and specially interested in child growth and development with implications for science teaching; will lead discussion group on "More Realistic Program and Lesson Planning for the Teaching of Elementary Science," Friday, March 25.

BROTHER I. ANSELM, F.S.C., De LaSalle High School, Chicago. Will discuss "Making Projects Serve Our Individual Needs" in the biology "Here's How I Do It" session, Saturday afternoon, March 26.

LOUISE LYONS, Steubenville High School, Ohio. Chairman of convention planning committee; will "open" the convention at general session, Thursday afternoon, March 24.

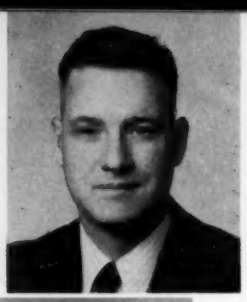
CARL MANSFIELD STUDIO

MORRIS MEISTER, Principal, High School of Science, New York City. Past President of NSTA (1946-48); retiring chairman of Cooperative Committee on Teaching of Science and Mathematics (AAAS); will serve as toastmaster at annual convention banquet, Friday evening, March 25.

PAUL F. BRANDWEIN, Forest Hills High School, New York City. Biology teacher, department chairman, and college instructor (Teachers College, Columbia University); will conduct clinic session, Saturday morning, March 26 on "The Gifted Student in Science."

CINCINNATI · March 24-26

HIGHLIGHTS



GORDON WOODWARD, Old Woodward High School, Cincinnati. Co-chairman of local committee on instructional exhibits.

MRS. ROBERT BECKER, Old Woodward High School, Cincinnati. Co-chairman of banquet committee.

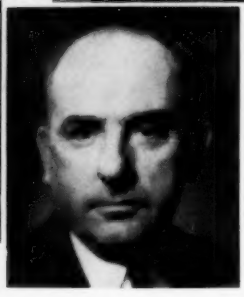
ROBERT BECKER, Old Woodward High School, Cincinnati. Co-chairman of banquet committee.

EDMUND MONTGOMERY, Old Woodward High School, Cincinnati. Chairman of arrangements committee.

HERMAN SCHNEIDER, Great Neck, New York. Consultant in elementary science, author and co-author of numerous children's science books; will speak on "Realistic Teaching of Science Challenges the Gifted Child" in the elementary science clinic, Saturday morning, March 26.

JOAN BOLLENBACHER, Supervisor, Appraisal Services, Cincinnati Public Schools. Chairman of registration committee.

GEORGE HOXIE STUDIO



IRA C. DAVIS, University of Wisconsin, Madison. Professor of Education; will lead discussion group on "More Realistic College Programs and Certification Requirements for Science Teachers," Friday, March 25.

HAROLD P. FAWCETT, Ohio State University, Columbus. Professor of Education (Mathematics) and Chairman of the Department of Education; will speak on "The Nature of Proof in Science" at Ohio Science Education Association luncheon, Saturday, March 26.

CINCINNATI · March 24-26

Graphic Representation of Student Interests in Science

By SAM S. BLANC

East High School, Denver, Colorado

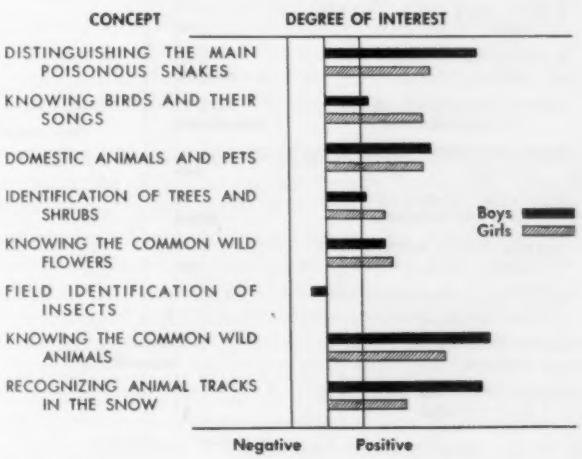
DURING a project undertaken several years ago in relation to the interests of Junior High School pupils in major areas of science,[1] a group of data was accumulated showing likes and dislikes for various concepts relating to each area. It was felt that it might be of value to develop a technique for graphically indicating the positive and negative interests of each group of students for the various science concepts included in the survey.

To devise a comparable unit for a graphic indication of the degree of interest shown for each item by each of the six groups of pupils tabulated, the significant differences of per cent for each group were used as starting points. It was felt that if the statistically significant differences in per cent of the likes and dislikes were used as arbitrary linear units to indicate one degree of interest for each item on the graph, then twice that difference could be shown as a bar twice as long, three times the difference should be thrice as long, and so on. In this manner a comparable linear unit of indicating the degrees of interest for each item was developed.[2] It must be remembered that these degrees of interest do not show a statistical relationship. They merely indicate a linear relationship for the purposes of comparison. All that may be concluded from these graphs is that a long bar indicates a higher degree of interest, or lack of interest, than a short bar.

The representation of the degrees of interest for each item surveyed was accomplished by computing the difference of per cent in the *Like* and *Dislike* checks for each item. By transposing the meaning of each of these differences of per cent into linear degrees of interest, it was possible to construct a bar graph for each concept of science, boys and girls separately, in each of the areas studied. Since the difference in per cents was not statistically significant below the value of one unit, that area on each graph was indicated by two lines, one to the right and one to the left of the base line. All values were shown on these charts, but it must be remembered that only those extending beyond these two lines, to the right or to the left, indicate a statistically significant degree of interest.

A total of sixty graphs were constructed in order to portray adequately the variations of interest among the seventh, eighth, and ninth grade levels in each of the twenty areas of science included in the original survey. The graphs were constructed so that the positive interests are shown extending to the right of the base line, and the negative interests are shown to the left. A few of the charts are illustrated in the accompanying figures, one each for grades seven, eight, and nine.

Interest of seventh grade pupils in nature study

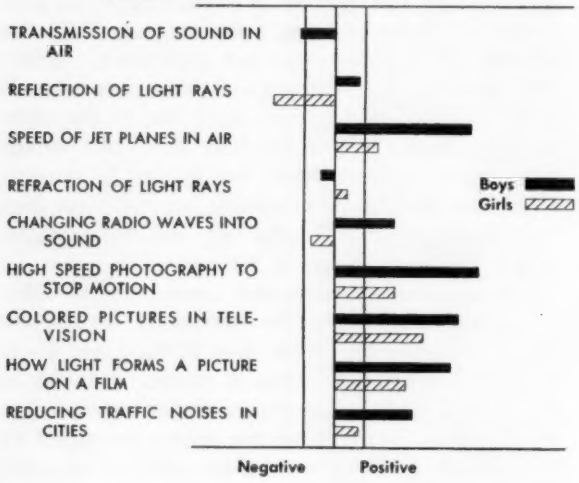


[1] Sam S. Blanc, "Science Interests of Junior High School Pupils"; *School Science and Mathematics*, 51: 745-752, December, 1951.

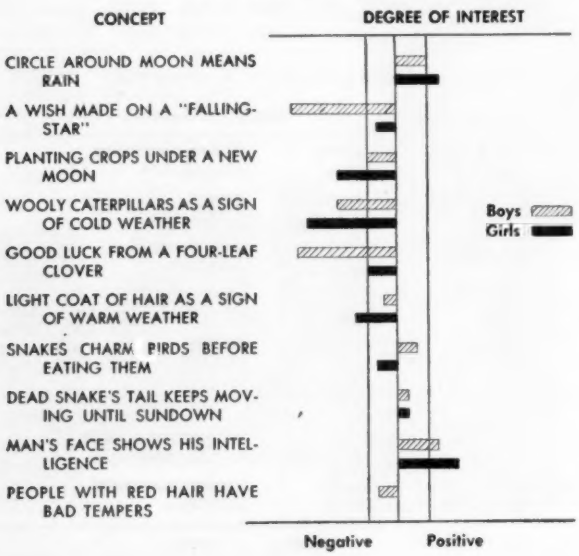
[2] Sam S. Blanc, "A Technique for a Statistical Interpretation of an Interest Survey Questionnaire"; *Journal of Educational Research*, 47: 223-227, November, 1953.

In reading the charts, the simplified statement of the particular concept graphed is found to the left. The results of the pupil responses, boys and girls separately, are shown by the horizontal bars for each item. The area between the base line and the two lines marked to the right and left of it has no significance in the results. The bars extending beyond these delimited areas may be considered statistically significant. The greater the length of the bar, the greater the interest or lack of interest interpreted for that concept. By glancing at the general profile of the chart for each of the twenty areas considered, a quick measure of the general interest exhibited by each grade level may be seen.

Interest of eighth grade pupils in light and sound



Interest of ninth grade pupils in superstitions in science


CONCEPT
DEGREE OF INTEREST
CIRCLE AROUND MOON MEANS RAIN
A WISH MADE ON A "FALLING-STAR"
PLANTING CROPS UNDER A NEW MOON
WOOLY CATERPILLARS AS A SIGN OF COLD WEATHER
GOOD LUCK FROM A FOUR-LEAF CLOVER
LIGHT COAT OF HAIR AS A SIGN OF WARM WEATHER
SNAKES CHARM BIRDS BEFORE EATING THEM
DEAD SNAKE'S TAIL KEEPS MOVING UNTIL SUNDOWN
MAN'S FACE SHOWS HIS INTELLIGENCE
PEOPLE WITH RED HAIR HAVE BAD TEMPERS
Boys
Girls
Negative
Positive

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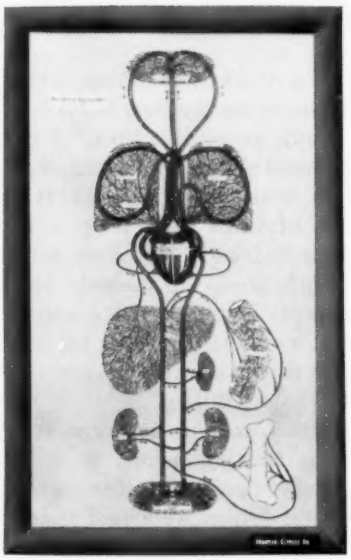

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REPORTS FROM NSTA AFFILIATED GROUPS

A Staff Summary

During the fall months, we made an effort to contact all NSTA Affiliated Groups and obtain up-to-date information on their officers and programs of activities. Responses with summaries of activities were received from 39 of the groups. Don't you agree this is a good response from a total of 63?

We are pleased to publish this summary report. In the past, space limitations in THE SCIENCE TEACHER *have not permitted full reporting of the many interesting news items we have received. We regret this, but are looking forward to the possibility of a regular "Affiliated Group Activities" page as increasing NSTA membership permits an expanded format or an increase to eight issues of TST.*

The groups are listed alphabetically with the names of the president and secretary given in that order. Then follows a brief summary of activities for 1954-55. Other groups whose reports did not reach us in time to be included in the summary are listed at the end. We hope all groups will find this report to be an interesting and helpful exchange of ideas and experiences with groups efforts to improve science teaching.

The long-standing policy of NSTA has been to seek and strengthen cooperative relationships with other science teacher groups. It is recognized that many activities directed toward our common goals are best planned and carried out at local, state, or regional levels. On the other hand, some of the most perplexing problems and most needed services—as well as opportunities for action—clearly point to programs and endeavors carried out on a national scale. By relating these various efforts more effectively, far more can be accomplished than by divided effort. Suggestions, constructive criticisms, and continuing evaluation in relation thereto are most welcome. EDITOR.

ARIZONA SCIENCE TEACHERS ASSOCIATION. LORENZO LISONBEE, Phoenix Camelback H. S.; H. H. COFER, West Phoenix H. S. ASTA sponsored the first Science Fair to be held in Arizona last April; is making plans for two regional and a number of local Science Fairs this school year.

ASSOCIATION FOR THE EDUCATION OF TEACHERS IN SCIENCE. NED BRYAN, Rutgers University, New Brunswick, N. J.; F. L. FITZPATRICK, Teachers College, Columbia University, New York City. Annual meeting of the Association was held in November at Teachers College, Columbia University, New York City; the theme for the meeting was "Science and Society." Spring meetings will be held at Iowa State Teachers College, Cedar Falls, and Connecticut State Teachers College, Willimantic. The problem of science teacher supply will be emphasized in plans for 1955.

CALIFORNIA SCIENCE TEACHERS ASSOCIATION, NORTHERN SECTION. EUGENE ROBERTS, San Francisco Public Schools; CHARLES SEFFENS, San Lorenzo. Fall Institute of the CSTA-NS met in Richmond in October. In December the Association took a part in the Western Regional Conference of NSTA held in Berkeley in conjunction with the American Association for the Advancement of Science; served as a sponsor of a special Junior Scientists Assembly for the science-minded youth of the San Francisco area. Spring meetings will include the Second Annual Bay Area Science Fair, April 15-21; a special science program sponsored by the National Association of Manufacturers, April 16; and the regular spring meeting May 7, in the Hayward area. A feature of the Hayward meeting will be the field trip to an actual fossil diggings; the theme of the meeting will be geology-paleontology.

CALIFORNIA SCIENCE TEACHERS ASSOCIATION, SOUTHERN SECTION. GEORGE R. TRACY, Long Beach Polytechnic H. S.; LOLA STEINER, Burbank. A mass meeting of science teachers was held in October at the California Institute of Technology with address, lectures, and demonstrations in various branches of science by faculty members of the Institute. Will serve as co-sponsor of the Southern California Science Fair. Publishes a periodic mimeographed bulletin called the *Capsule*. Plans to organize a few field trips; will attempt a study of the status of science teacher societies in the state pointing toward affiliation for all groups with CSTA and NSTA.

CHEMISTRY TEACHERS CLUB OF NEW YORK CITY. ETHEL N. SARAFIAN, Bay Ridge H. S.; IRWIN H. GAWLEY, Tenafly H. S., N. J. Professional interest to keep abreast of recent developments in chemistry was the general theme for the October meeting which featured a talk on "Hydrazine," and for the December meeting at which a talk on "The Processing of Taconite" was given. A demonstration meeting with members of the Club performing was held in February. The Annual Dinner Meeting will be held in May.

CHICAGO CATHOLIC SCIENCE TEACHERS ASSOCIATION. REVEREND REINHOLD LINK, St. Joseph Seminary, Westmont, O.F.M. BROTHER CONRAD, F.S.C.; Chicago. Forty-ninth meeting of the Association was held in January at the Academy of Our Lady, Chicago; included an address on "The Challenge of Engineering Education" and the usual sectional meetings for subject-matter areas. The founder of the Association gave a Retrospect of Fifty Meetings at the April meeting held at Lewis Towers, Loyola University, which coincided with the anniversary celebration of the 50th meeting of the organization. September meeting took place at

Camp Sagawau in the Forest Preserve District of Cook County. The film, "Yours is the Land," was shown; field trips in the areas of aquatic life, plant life, and soil were scheduled.

CHICAGO TEACHERS SCIENCE ASSOCIATION. EMILIE U. LEPTHIEN, Public Schools; T. W. WALLSCHLAEGER, Palmer Elementary School. Program provides for alternating meetings and field trips and tours. Sponsored three regional science fairs, participated in the National Convention of NSTA in April, and will assist at the March meeting of the National Council for Elementary Science. Since the greatest percentage of membership comes from the elementary school teachers, the programs are arranged to meet their needs.

CONNECTICUT SCIENCE TEACHERS ASSOCIATION. ELIZABETH ANN QUINN, Stamford; LUCILLE KUHNLY, Rockville. Third Annual Convention Day Meeting was held at Farmington High School, Unionville, in October; highlight of the year will be the 1955 Connecticut Conference on the Teaching of Science, April 1-2, Yale University, New Haven; theme for the meeting is "A Growing Science Curriculum for the Growing Child." CSTA received recognition on the "Yale Interprets the News" radio program which featured an interview with a Yale chemistry professor on the topic, "Critical Problems Face Science Teachers."

DETROIT BIOLOGY CLUB. NATHANIEL WM. KATZ; ELIZABETH HALFERT. Program features lectures, demonstrations, and films on such topics as teaching a high school course in floriculture, education over television, travels in Alaska; will be supplemented by a visit to the University of Michigan greenhouses at Ann Arbor, a behind the scenes tour of the Detroit Zoological Park, a springtime trip to a commercial rhododendron and azalea garden, and two weekends at the Department of Conservation Training Camp, Higgins Lake.

DIVISION OF CHEMICAL EDUCATION, AMERICAN CHEMICAL SOCIETY. C. A. VANDER WERF, University of Kansas, Lawrence; GRANT W. SMITH, Pennsylvania State University, State College. Activities include publication of the *Journal of Chemical Education*, sponsorship of summer workshops and institutes for chemistry teachers, preparation and distribution of the ACS cooperative examinations in chemistry, publication of handbooks for chemistry teachers and assistants, scheduling of programs at every national meeting of the ACS, and supervision of the annual Scientific Apparatus Makers Association Award in Chemical Education.

ELEMENTARY SCHOOL SCIENCE ASSOCIATION, NORTHERN CALIFORNIA SECTION. J. MARTIN WEBER, Sacramento County Schools; GERTRUDE WITHERSPOON CAVINS, San Jose State College. Fall meeting was held at Hayward Union High School with President-elect (NSTA) Stollberg giving the keynote address, "From Curiosity to Creativity." Spring meeting is scheduled for April 16 at Chico; conference will be centered around: "The Field, Your Outdoor Laboratory." Served as hosts for the Social Mixer at the Western Regional Conference held in Berkeley in December in conjunction with the AAAS meeting.

FEDERATION OF SCIENCE TEACHER ASSOCIATIONS OF NEW YORK CITY. ALEXANDER TAFFEL, James Monroe H. S.; DOROTHY J. SUSSKIND, Theodore Roosevelt H. S. Federation is an association of six science teacher organizations. Meetings of the entire membership are held in November and March. Publishes *The Teaching Scientist* twice yearly featuring articles on science teaching and demonstration techniques. Executive body of the Federation, the Science Council, meets monthly to set basic policies and to plan the program.

FLORIDA ASSOCIATION OF SCIENCE TEACHERS. N. E. BINGHAM, University of Florida, Gainesville; LOIS ALLSWORTH, Miami. Association is the organization of science teachers of the FEA; holds its annual meeting with the FEA. Jointly sponsored with National Association of Biology Teachers, a luncheon meeting at the time of the AIBS convention. Will take an active part this spring in sponsoring five Science Fairs.

GENERAL SCIENCE ASSOCIATION OF NEW YORK. ISADORE HALPERN, Erasmus Hall H. S.; MARIE MONKS, City Island. Through meetings and committee work the Association will help to evaluate a tentative revision in the course of study for general science in grades 7-9; revision is directed toward closer articulation with the modern objectives of education. Upward salary revisions to benefit present science teachers and to attract future science teachers will be studied.

HILLSBORO COUNTY, FLORIDA, SCIENCE COUNCIL. RUBY W. LITTLEFIELD, Tampa; VIVIAN BURROWS, Tampa. A Science Fair Preview was set up in November at the Florida Education Association District Meeting, University of Tampa Library; plans are now under way for a Science Fair this spring on the basis of the attendance at the Preview.

METROPOLITAN BRIDGEPORT SCIENCE TEACHERS. ROBERT W. SHACKLETON, Roger Ludlowe H. S., Fairfield, Conn.; ALVIN GENDALL, Johnson Jr. H. S., Stratford, Conn. Association will undertake two major projects in addition to the monthly meetings. Will sponsor the Sixth Southern Connecticut Science Fair, April 22-23, Fairfield University, Fairfield, and be host to the New England Science Exhibition, May 6-7, University of Bridgeport.

METROPOLITAN DETROIT SCIENCE CLUB. RAY BIGLER, Wayne University; CHARLES BREEDLOVE, Cody H. S. Main meeting of the year, MDSC Institute Meeting, was held in January at Wayne University; the theme for the meeting was "Channel 56, Investment

in Our Future." A highlight of the meeting was the half-hour closed circuit TV program in both primary and secondary levels showing science teachers the actual techniques encountered in putting on a TV program. A speaker related problems and successes associated with science on the Educational TV stations.

MISSOURI SCIENCE TEACHERS ASSOCIATION. D. C. HANLEY, Hannibal H. S.; ELMER HEADLEE, Kirkwood H. S.

NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING. KENNETH E. ANDERSON, University of Kans., Lawrence; CLARENCE M. PRUITT, University of Tampa, Fla. "The Second Annual Review of Research in Science Education" appeared in the December issue of *Science Education;* a general chairman and level chairmen for the Third Annual Review have been appointed. The Twenty-Eighth Annual Meeting will be held at Teachers College, Columbia University, April 18-20.

NATIONAL INSTITUTE OF SCIENCE. CLARENCE T. MASON, The George Washington Carver Foundation, Tuskegee Institute, Ala.; WALTER R. TALBOT. A bimonthly News Letter from the office of the secretary, the *Transactions* published annually, and the annual meetings held at various colleges in April are part of the program to promote scholarly production in basic science, research, and science education.

NEW ENGLAND ASSOCIATION OF CHEMISTRY TEACHERS. JOHN A. TIMM, Simmons College, Boston; LEALLYN B. CLAPP, Brown University, Providence. Meetings have been held at New Hampton School for Boys, New Hampton, N. H.; Wentworth Institute, Boston, Mass., and Mitchell College, New London, Conn. Meetings will be held April 23 at St. Joseph College, West Hartford, Conn.; and May 14 at Framingham State Teachers College, Mass. The 17th Annual Summer Conference will be held August 15-20 at Tufts College, Medford, Mass.

NEW ENGLAND BIOLOGICAL ASSOCIATION. MALCOLM D. CAMPBELL, Dorchester High School, Mass.; HELEN G. MAUK, Haverhill High School, Mass. October meeting was held in cooperation with the Nature Conservatory at the Crane Estate, Ipswich, Mass. December meeting was held at the Wentworth Institute, Boston. March meeting is scheduled for the Massachusetts Blood Laboratory; May meeting for the Rhode Island College of Education, Providence. Subjects for the meetings include "Micro-Climates," "Health of High School Students," "Blood—Typing and Derivatives."

NEW JERSEY SCIENCE TEACHERS ASSOCIATION. MAITLAND P. SIMMONS, Irvington H. S.; HOWARD B. TROMBLEY, Grover Cleveland H. S., Caldwell. Plan to publish a brochure, *Fifty Years and Onward,* on the occasion of their 50th Anniversary. Yearly program centers around five major events ending with the Annual State Science Day sponsored with Rutgers University; four full-time tuition scholarships are awarded at this meeting to students making high score on competitive exams in biology, physics, chemistry, and engineering. A State Scroll is presented to an outstanding scientist or science educator at the Annual Atlantic City Conference. Themes for two of the meetings were: "A Day in Industry" and "A Day in Education (Community Science in Somerville High School)." Annual Business Meeting and Election of Officers to be at the New Jersey Secondary School Conference, Rutgers University. Other activities include the sponsoring of a certificate of merit, awarded to TV stations for the best science educational program. Official publication, the *New Jersey Science Teachers Association Bulletin,* is issued five times yearly.

NEW ORLEANS SCIENCE TEACHERS ASSOCIATION. EVELYN M. MARCOTTE, Beauregard Jr. H. S.; EVELYN REAMES, John McDonogh Senior H. S. Program will include an airplane flight over New Orleans and its environs; day outings to such places as the wild life preserves at the mouth of the Mississippi, tung groves of the Florida parishes, a paper mill, paper box factory and hand-planted forest of the Gaylord Corp., and a sugar mill are planned. On the outings the host company entertains at lunch or picnic lunches are planned for interesting spots along the way.

NEW YORK ASSOCIATION OF TEACHERS OF BIOLOGICAL SCIENCES. HERBERT A. NESTLER, F. K. Lane H. S.; SAMUEL BROWNSTEIN, Wingate H. S. and Marian Richter, Morris H. S. Plans include six membership meetings and six spring outing field trips. Committee work has been suspended pending the outcome of a salary campaign.

NEW YORK STATE SCIENCE TEACHERS ASSOCIATION. MARIAN E. RUSSELL, Senior H. S., Perry; ELDRED L. ROSS, High School, Walden. Activities will be directed toward the goals as established in the Constitution; they include working toward an increase in membership, improvement in public relations, a worthwhile summer and winter meeting, study of desirable science laboratories and equipment, better certification requirements, and encouraging future science teachers.

OHIO SCIENCE EDUCATION ASSOCIATION. CHARLES E. HOEL, Bexley H. S., Columbus; RALPH BERNARD, Risingsun. A department of the Ohio Education Association; offers units, speakers, and consultation services to Ohio science teachers.

OKLAHOMA SCIENCE TEACHERS ASSOCIATION. LEO L. RODRIGUES, Ponca City, *President.* Highlight of 1954 was the state meeting held in Oklahoma City in October; the main address was on "Tactics and Strategy in the Science Classroom." Aim for 1955 is

to promote coordination between groups and an understanding of the problems common at all levels.

ORANGE COUNTY, CALIFORNIA, SCIENCE TEACHERS ASSOCIATION. Gordon R. Hjalmarson, Huntington Beach H. S.; John J. Johnson, Newport Harbor Union H. S., Newport Beach. Local county meetings were held at Santa Ana High School in October, Orange Coast College in December, and Garden Grove High School in February. A meeting is scheduled for Santa Ana College, April 28.

PENNSYLVANIA SCIENCE TEACHERS ASSOCIATION. Herbert H. Reichard, Allentown H. S.; E. Jane Northey, Mary J. Cowley School, Pittsburgh. Second Annual Conference brought over 125 teachers to a very successful meeting at Muhlenberg College, Allentown, in July 1954; NSTA President Walter S. Lapp, Overbrook High School, Philadelphia, gave the keynote address on "The Challenge in Science Teaching." The Christmas meeting was held in December at Harrisburg with the Pennsylvania Science Education Association; the results of a study on "Current Science Teaching Practices in Pennsylvania" were presented. Third Annual Conference is scheduled for July 22 and 23 at State Teachers College, Indiana, Pa. Official publication is *The Pennsylvania Science Teacher*.

THE PHILADELPHIA SCIENCE TEACHERS ASSOCIATION. Mae Coole, Huntington Valley; S. Theodore Woal, Philadelphia. Fall "Get Together" was held in October to meet newly appointed science teachers and to honor those who retired. Meeting in December in connection with the All-Philadelphia Teachers Meeting featured talks by a Ford Foundation Fellow and a research chemist. March meeting will be tied in with "Schoolmen's Week" at the University of Pennsylvania. Meting on May 4 will be with members of the Franklin Institute at the Institute.

PHYSICS CLUB OF PHILADELPHIA. Robert H. Bradbury, Northeast H. S., Mildred Luzader, Remington Rand Corp. First meeting was held in November with the Pennsylvania Conference of Physics Teachers at Swarthmore College. Meeting in December was with the Franklin Institute at the Institute; featured a talk on "Jet Propulsion." February meeting was held at the new Physics Building, University of Pennsylvania, Philadelphia. April meeting will be a dinner meeting at the Philadelphia College of Pharmacy and Science.

PUERTO RICO SCIENCE TEACHERS ASSOCIATION. Mrs. Josefina Martinez, Lares H. S.; Mrs. Flor de Ma. Pardo Quinones, Central H. S., San Juan. Although inactive for several years, the Board of Directors plans to carry out a series of specific programs to build up the organization; plans have been made for a Convention this semester.

SAINT PAUL COUNCIL OF SCIENCE TEACHERS. James Cusick; Barbara Young.

SCIENCE CLUB OF INDIANA, PENNSYLVANIA, STATE TEACHERS COLLEGE. Lawrence W. Isaac; Shirley M. Wilsman. Program will be directed toward the following fields of interest: physics, chemistry, biology, astronomy, and social activities. One outing will feature a star study by a member who's an amateur astronomer. Student projects will constitute another program.

SCIENCE SECTION, LOUISIANA EDUCATION ASSOCIATION. Mrs. Austin Miller, Monroe; Mrs. Ruby Fitzgerald, Bossier H. S., Bossier City. Met with the LEA in Monroe in fall; featured speaker was the Director of Research and Medicine at Oak Ridge Institute of Nuclear Studies; afternoon panel discussion considered "How I Use the Natural Interest of Children in Teaching Science." Section plans to work with Junior Academy of Science in sponsoring Science Fairs in the 10 districts of the state. Spring meeting will be held at Louisiana State University.

SCIENCE TEACHERS OF NEW ENGLAND. Arthur T. Burroughs, Lexington, Mass.; Sr. Mary Walter, S.S.N.D., Roxbury, Mass. Spring meeting in 1954 was held at State Teachers College, Worcester, Mass.; theme for the meeting was "Why Do Some Schools Have an Effective Science Program?" Fall meeting was held at Boston College in October; a panel discussed "The Early Recognition of Science Potential"; implications were considered.

SEATTLE ASSOCIATION OF SCIENCE TEACHERS. J. Franklin Peters; Wenonah Sullivan. Varied programs for each monthly meeting describe the activities; lectures, reports, films, studies, and experiments deal with such topics as radioisotopes, gliders, genetics, a new educational TV station, and summer activities—workshops and fellowships.

STUDENT AFFILIATE GROUP, SAN JOSE, CALIFORNIA, STATE COLLEGE. John A. Donnan; Joan Winterling. Activities are those of a group of teaching majors and minors in the life sciences, physical sciences, and conservation; most of the members of the group are in their senior or graduate year and are working toward both a M.A. and General Secondary Credential. Many of the group actively participated in the Annual Winter Meeting of NSTA held at the University of California, Berkeley in conjunction with the AAAS in December.

TENNESSEE SCIENCE TEACHERS ASSOCIATION. Conrad W. Bates, Chattanooga H. S.; Mrs. Ramon S. McCrory, Lawrence County H. S., Lawrenceburg. Association is making a study of curriculum development for the integration of nuclear energy into the science program. A program at the annual meeting, April 1, will highlight the helps available to teachers for presenting lessons on atomic energy and nuclear physics; assistance will be provided by the Oak Ridge Institute of Nuclear Studies.

WEST VIRGINIA SCIENCE TEACHERS ASSOCIATION. DONALD C. MARTIN, Marshall College, Huntington; MRS. HELEN BARRAR, Charleston. Two meetings—one for elementary and one for high school teachers—were held at the WVEA meeting in Charleston in October. A small news bulletin for members will be issued two or three times during the year. A recognition award for outstanding science teachers is being considered. Annual meeting will be held in April at Fairmont State College in conjunction with West Virginia Academy of Science; group will cooperate in the promotion of the Junior Academy of Science Program and the State Science Fair held at the meeting.

OTHER AFFILIATED GROUPS

American Association of Physics Teachers.
American Nature Study Society
Association of Laboratory Assistants, New York City
Combined Science Roundtable of South Dakota Education Association
Earth Science Institute
Georgia Science Teachers Association
Henry County, Illinois, Science Teachers Association
Illinois Association of Chemistry Teachers
Iowa Association of Science Teachers
Maryland Science Teachers Association
Middle States Science Teachers Association
Nebraska Science Teachers Association
North Country Science Teachers Association
Northern Minnesota Science Teachers Association
Physics Club of New York City
San Diego Science Teachers Association
Science Club of West Chester, Pennsylvania, State Teachers College
Science Section of Arkansas Education Association
Science Section of North Dakota Education Association
Science Supper Club of Norfolk County, Virginia
Secondary Science Section of the Virginia Education Association
Texas Association of Science Teachers

MECUM—continued from page 74

crippled his own body, he set his will to conquer it. He could not forget that he was the son of a Napoleonic warrior and the father of a beaten and lost son when France succumbed to the German onslaught. He went into the hospitals and was appalled at the torture and death. During a lecture at the Academy of Medicine: [30]

> One can scarcely understand the surprise, and the stupefaction, even, of the medical men and their students when . . . with a simplicity and an assurance which seemed presumptuous in a man who was entering a lying-in hospital for the first time Pasteur criticized the methods of dressing wounds, and declared that all bandages should be placed in a sterilizing oven.

Although many of Pasteur's strongest adherents were Evolutionists, such as John Tyndall, it is unlikely that Pasteur, himself, had any particualr intention of defending this theory. His [31] tenets of specific characteristics transmitted through a continuing germ cell served well as a point of departure for natural selection and the survival of the fittest, but he did not attempt to clear the origin of the germ cell. His efforts aimed at discrediting the extravagant, but scientifically sterile claims of the heterogeneticists who made life an unnecessary corollary of matter and offered ambiguous platitudes, or slipshod examples as proofs.

Ignoring Lamarck and the gloom of [31] "dei ex machina" contemporaries, without trying to conjure up missing links or reduce nature to unity, he found hope and courage in his laboratory. Devoutly religious he would not have fully accepted the [32] "entelechism" or [33] "elan vital" of Bergson's [34] *"Creative Evolution,"* nor did he trust pure reason. At Arbois he warned,[35] "it is still more impossible to believe that *reason* has the power to deal with the problems of origins and ends."

His "ends" did not include swords or pistols. Challenged to a duel by eighty-year-old Dr. Jules Guerin, who had become infuriated over Pasteur's counter-attack in a discussion of the role of vaccine in smallpox, Pasteur refused, but not through fear. When someone was needed for testing his vaccine he asked his assistants to inoculate him with live rabies germs. Still more courage was needed when knowing he must fail and face popular scorn, he consented to apply his newly tested preventative to a dying girl.

[36] "A man of science . . . should think of what will be said of him in the following century, not of the insults or the compliments of one day."

When the origin of pebrine was needed, Pasteur applied what he had learned from his research on spontaneous generation and found it in the silkworm egg; when anthrax was raging, he not only produced a vaccine, but explained that phase of immunology and applied it to the control of other diseases. The wine industry was rescued from bankruptcy by "Pasteurization" and the projected use of his method with milk saved the lives of countless millions. His techniques have set the pace for

various types of food preservation for more than a century. His research stimulated and aided other scientists of his time; as Lister in using antiseptics, and John Tyndall in "Tyndallization," and his influence reverberates like a chain reaction not only through the Pasteur Institute, but through the entire world.

Pasteur did not attempt to rationalize the distance between good results in the laboratory and human desire probing mystery: [37]

> What is beyond? The human mind will never cease to ask that question. Beyond is infinite space, infinite time, infinite grandeur. He who proclaims the existence of the Infinite . . . and who can help it—declares by that statement more of the supernatural than can be found in all the miracles of religion: . . . Everywhere I see an expression of the Infinite and because of that, in every heart there is something of the supernatural.

Thus we see the man tower above his proofs when absolutes must be softened to probabilities as they are in the confused world of today. Probabilities are based upon assumptions from which the entire tissue of reason is developed; therefore one can never succeed in being entirely correct. Spontaneous generation was a theory which could not be disproved conclusively because a perfect induction is practically impossible. Nevertheless theories, right or wrong, are productive if aired sufficiently.

Today as we read of tobacco mosaics, viruses, enzymes, hormones, isonucleic acids and [38] "myelin" figures we can hear Pasteur answer G. G. Simpson! [39]

> Current studies suggest that it would be no miracle, nor even a great statistical impossibility, if living molecules appeared simultaneously under special conditions of surface waters rich in carbon compounds that are the food and substance of life.

Thoughtfully he says: [40]

> I have been looking for spontaneous generation during twenty years without discovering it. No, I do not judge it impossible. But what allows you to make it the origin of life? You place matter before life and you decide that matter has existed for all eternity. . . . How do you know that in 10,000 years one will not consider it more likely that matter has emerged from life?

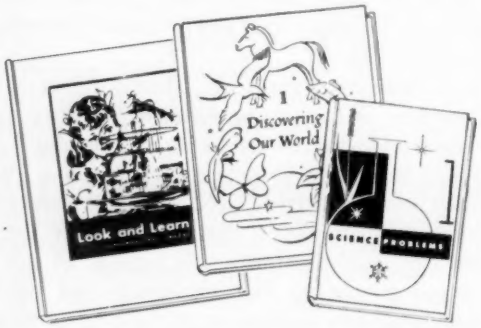
From this and other posthumous material we must conclude that the matter of spontaneous generation was always just beneath the surface of his thoughts. Although he lived in a world of dust, he would not concede to it his origin. He sent the pseudo-scientists back to ponder the implications

For Today's Science-Minded Youngsters . . .

BASIC STUDIES IN SCIENCE

W. L. Beauchamp, Director

In this scientific age, today's science course should teach not only science *facts* and *concepts*, but the *method* of science as well.



Each of the Scott, Foresman science texts—picture-method primary, doing-and-discovering middle-grade, unit-problem upper-grade—is organized so that boys and girls must think things through for themselves, find answers as a result of their own activity; apply to new situations concepts and facts they have learned.

When science is taught this way, pupils acquire the method of science so that it carries over into their everyday living and thinking.

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of First Cause and Determinism before setting themselves up as authorities. He unveiled fraud, battled ignorance and superstition, quieted scoffers and lived dynamically by his beliefs. His attitudes became the criteria of the scientist. Because of his work people began to realize the necessity for both the knowledge and practice of scientific findings. He responded to every major popular crisis of his district: industry, agriculture, or health. He placed chemistry firmly into the realm of biology. Beams from his Institute still enhance the life expectancy of each one of us. His interest in origins added laboratory research to the medical profession and pointed it to the highest sociological goal of all—the prevention and relief of human suffering.

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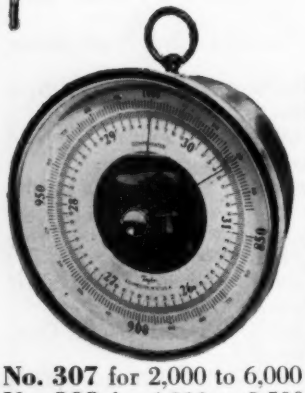

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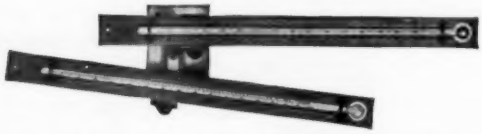

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SCIENCE ASSOCIATES

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Classroom Ideas

Chemistry

Nurturing Laboratory Interests in Chemistry

By HARRY KUNER, Abraham Lincoln High School, Philadelphia, Pennsylvania

Shortly after the opening of Lincoln High School, it was believed desirable to have students help keep the laboratories in order. Since some of these boys and girls are keenly interested in science, we decided that they should have some opportunity to nurture this interest.

In order to accomplish this, projects combined with service as laboratory assistants were undertaken by these students. The preparation room adjacent to the classroom became their workshop. There was no interference with the work of the class.

One student has become interested in qualitative analysis. He spends four periods a week in the laboratory—two on his analysis and two on routine laboratory chores.

Another boy has standardized a sodium hydroxide solution to be used later in a class experiment on titration. He titrated the sodium hydroxide solution against a standard hydrochloric acid solution. He has just completed a check on the standard hydrochloric acid solution by a gravimetric determination.

A laboratory experiment that we have used to prepare hydrogen involves heating powdered magnesium and water. We found that students frequently boil the water with the result that little or no hydrogen is obtained. One student met the challenge of discovering how to obtain better results. He tried heating the test tube of reactants in a beaker of hot water. We agree that this seems to be a better method. We are planning to try it in class next term.

While these boys and girls have needed direction, the outcomes have indeed been worth whatever extra effort is involved. First, they have added to their knowledge of chemistry. Then too, they are experiencing the joy that comes with the satisfactory development of an idea. It seems likely that the enthusiasm they show may be sufficiently contagious to set off a spark of encouragement among their classmates for this kind of work. Last, but not least, we cannot overlook the fact that the laboratory remains in good working order.

Biology

Eyepiece Micrometers

By H. FRANCIS HENDERSON, Oakwood School, Poughkeepsie, New York

While micrometer eyepiece disks are not too expensive, they frequently are not available in the high school laboratory. An inexpensive and reasonably serviceable substitute can be made from a piece of stiff celluloid (22mm plastic cover slips will do) with tools readily available in the laboratory.

The uppermost lens of the microscope eyepiece is removed and a celluloid disk is cut to fit inside the eyepiece and rest on the diaphragm. The disk is then placed on a clip board and clamped there with a microslide between it and the clamp. This microslide will serve as a reference mark and stop. By taking first one, then two, then three, etc., microslides on edge and ruling along them with a needle, accurate lines can be cut. Care must be taken to select slides of uniform thickness and to be sure that the slide pack lies against the reference slide. The disk may be rotated and the process repeated if square rulings are desired. The disk may then be dropped into the eyepiece, rulings down, and it is ready for use.

Of course, all eyepiece micrometers must be calibrated against a stage micrometer if direct measurements are required. For use in high school courses a millimeter scale is usually sufficiently accurate. The rule may be laid on the stage with surface illumination, and the number of graduations (estimating tenths) per millimeter determined. This must be done for each lens combination used.

The ruling, calibration, and occasional use of an eyepiece micrometer is an excellent aid to the student in visualizing the actual size of the objects he meets in the microscope.

A "Breadboard" Demonstration Radio Receiver

By CHARLES F. BECK, Bristol High School,
Bristol, Pennsylvania

There is a great deal of interest in electronics in our science classes. With limited time to cope with such an expanding field, teachers need aids which are time saving and effective in teaching the fundamentals.

The ordinary radio receiver circuit does not lend itself readily to being expanded for study. The metal chassis of commercial type sets is usually the ground. The "breadboard" set does not have this facility; therefore, the radio must be redesigned to make provision for a ground.

The schematic diagram used for the superheterodyne receiver shown was designed by an electronic engineer, Louis Potter, of Merchantville, New Jersey. It does not depart radically from the standard type five-tube receiver, and is of simple, rugged construction. It will receive the commercial broadcasts with fidelity and volume. Its playing ability compares favorably with commercial receivers.

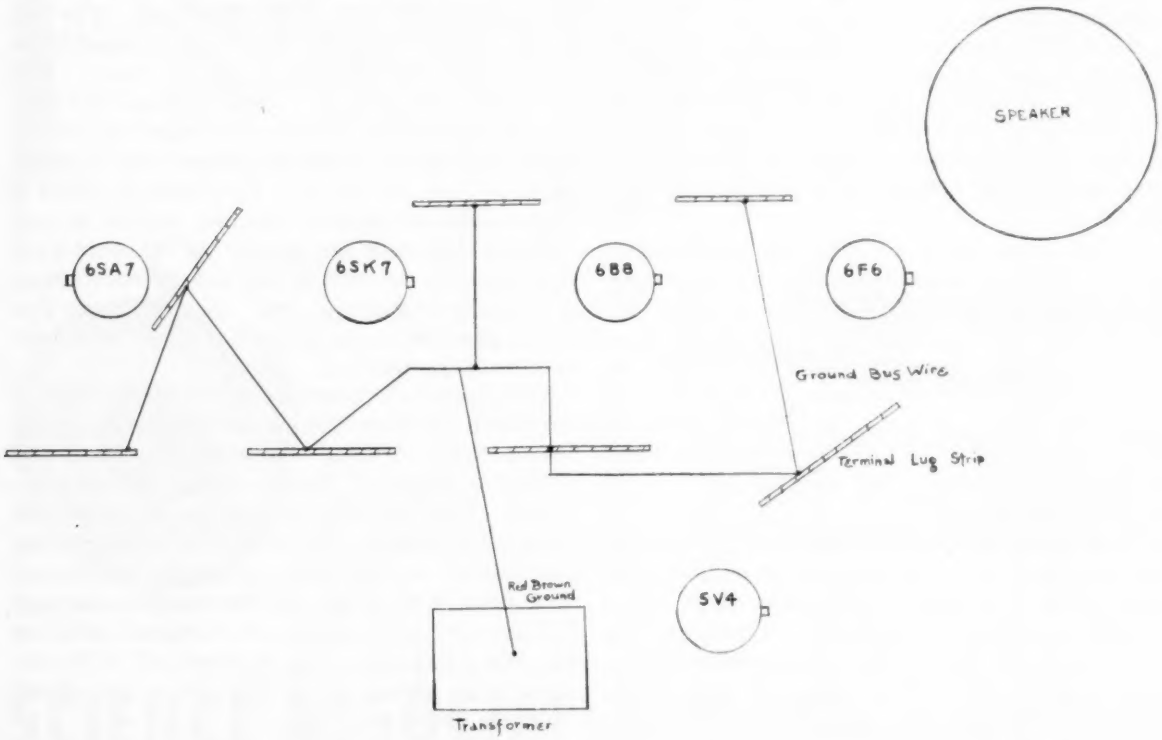
A step-down power transformer operating on 110-volt, 60-cycle alternating current is used with a 5V4 full-wave rectifying tube with choke coil and filter condenser. The filament circuit produces 6.3 volts for heating the tube cathodes.

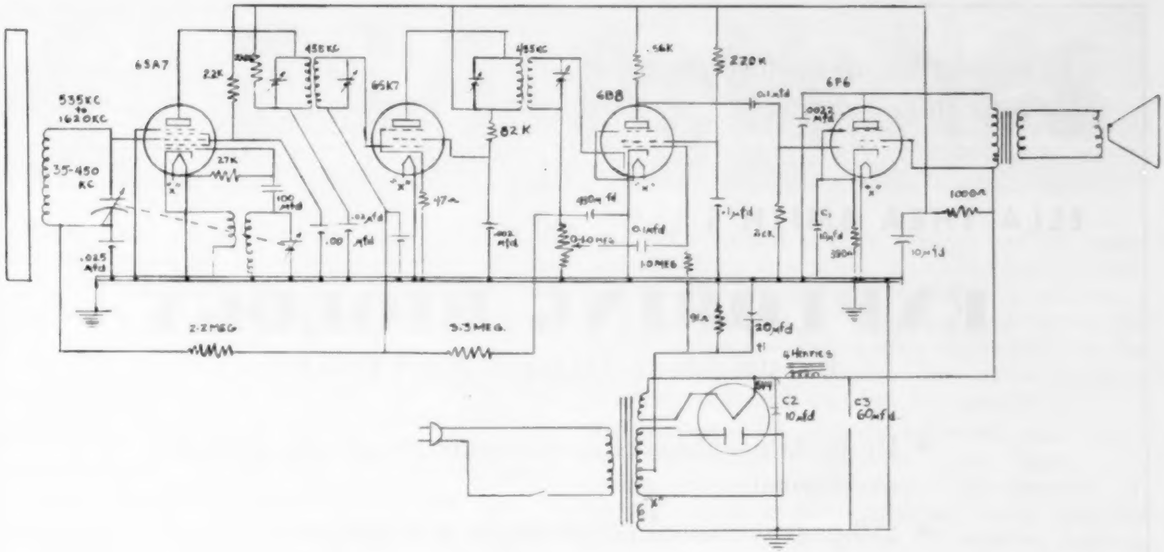
The ferrite rod antenna coil is a new type recently developed. No loop antennae is needed. Its performance has been very satisfactory under all conditions. The inductance of the coil must be changed to give the best performance by shortening the wire on the coil to match inductance of the set.

A heavy metal bus bar is used as the ground and is connected to the center tap of the power transformer. Connections are made easier by placing the ground close to the tubes in accordance with the schematic as illustrated below.

The converter, the intermediate frequency tube, the detector, and the power audio tube are spaced in line across the top of the panel. The power supply, rectifying tube, choke coil, and filter condenser are placed in line at the bottom of the panel. Plywood, 30 by 22 in., was used to make the panel. All components were attached to the board by the use of small screws.

Tune the set by adjusting the two IF transformers. Be sure to find proper inductance for the ferrite aerial by adjusting the length of wire on the rod to get the best signal while the set is turned on.





Components for Five-Tube Superheterodyne Radio Receiver

1 Antenna	Ferrite Rod Coil R. C. A.
1 Two-gang condenser	25-375 mmfd
1 Oscillator coil	For 6SA7 cathode feed-back
1 IF transformer	Input for 6SA7 converter
1 IF transformer	Output for 6SK7
1 Power transformer	1½-amp filament, 6.3 volts, 250 DC volts, 60 ma
1 Filter condenser	10 mfd, 450 volts
	20 mfd, 450 volts
	60 mfd, 50 volts
1 Audio transformer	8-ohm impedance output to match 6F6
1 Speaker, 4-inch; PM	8-ohm impedance
1 Volume control	0.5 megohms

Resistors and condensors other than the above are shown on the schematic. It is advisable to connect the open pin of the filter condenser to pin 8 of the 6F6 tube, and to ground the case of the volume control to eliminate hum.

Use of Demonstration Radio With an Oscilloscope

In order to demonstrate various wave patterns from the different parts of the receiver, you must first set up a sine wave on the oscilloscope. You can do this by making a short connection from the "test signal" to the horizontal input; also connect "external synchronize" to ground of "vertical input."

Then set: synchronous amplitude to 50
coarse frequency to 8
vertical amplitude to 20
horizontal amplitude to 80
vertical amplitude switch to amplitude
synchronous selector switch to exterior

Center the pattern, adjusting "horizontal position" and "vertical position." Also adjust "fine frequency" to synchronize wave pattern to produce sine wave. Then adjust "horizontal deflection" to get one sine wave. For sharpness and definition adjust "intensity."

Now connect leads to the "vertical input" and the ground of "horizontal input." Then connect ground lead to bus bar of receiver. The other lead from "vertical input" can now be placed about the set as desired.

Best results can be obtained by connecting C.R.O. to the grids of the tubes on the back of the panel. There is little response on the 5 pin—the grid—of the converter 6SA7 tube as the incoming signal is weak.

Connect to the 4 pin of the 6SK7 grid, the 6 pin of the 6B8 grid, and the 5 pin of the 6F6 grid. Each will give its corresponding impressed frequency response on the C.R.O. Best of all, if you connect to one of the speaker wires, you will receive excellent reproduction of impressed sound wave frequencies on your scope. Of course, have the receiver playing while testing. For best results use insulated leads with alligator clips for convenience. To eliminate shock, touch only one connection on the set at a time.

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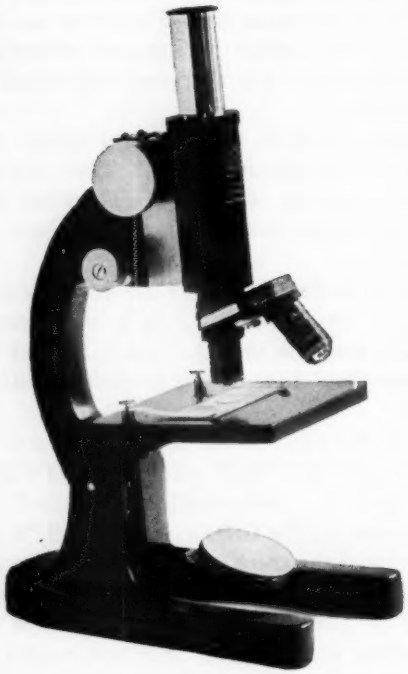

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FSA Activities

"Daddy, what do you do? At school yesterday we were supposed to tell what our parents do and, you know, I couldn't. You are always talking about Future Scientists but what do the people at your office really do?"

From this thought-provoking breakfast table conversation comes this month's FSA page. We hope it is of interest. At least it was good to step back for a moment and look at our operations. A wide variety of chores occupy each day. Perhaps brief excerpts from correspondence will show the types into which they fall.

Arranging—"Can you arrange for a small group to get together and judge the entries in this year's program of Recognition Awards for Science Teachers?"

Announcing—"Twenty-four universities are conducting a 1955 experimental program of Summer Research Assistantships for high school general science, biology, chemistry, and physics teachers."

Reminding—"Don't forget, applications for the 1955 West Coast Science Teachers Summer Conference must be postmarked not later than May 1."

Explaining—"Nothing is more elusive than a typographical error. The sentence to which you refer in last month's column should read—"The teachers will work approximately *200* hours assisting in the development of individual research projects."

Acknowledging—"We are glad to send the booklets being purchased by the Raritan Valley Subsection of the ACS for the teachers in your area."

Thanking—"On behalf of our Administrative Committee, I want to thank you and your company for the $1000 contribution in support of the 1955 program of our Future Scientists of America Foundation. We hope that our program being developed toward improving the quantity and quality of science teaching will warrant your continued interest and support."

Rewarding—"Congratulations! The judges have chosen your project as a first place winner in the 1954 program of Science Achievement Awards for Students. A check for $100, a gold FSA pin, and an appropriate certificate will be presented to you by our NSTA representative shortly after the opening of school next fall."

Producing—"Although the public relations values of such efforts are admittedly hard to measure, you may want to see the Chrysler Corporation identified with a job we have underway.

"Teachers need a student-level publication which spells out the tried and proved methods and procedures of research in science and engineering. Although written for adults, Killeffer's *The Genius of Industrial Research* suggests a pattern for such a booklet. He reviews in detail successful research projects and the reader can easily trace their origin, the step-by-step solutions, and the ultimate outcomes. A sample is attached.

"Could you help me track down the information needed to compose such a story but using a new research episode for the topic? How about the hemispherical combustion chamber, for example?"

Distributing—"We certainly appreciate your request for FSAF booklets. Unfortunately, our supply is becoming critical. *Student Projects* is completely exhausted and the second printing will not be ready for about ten days. I am sending 200 copies of *Available Materials and Services* and the Awards flier. I hope we have included enough copies of *Careers in Science Teaching* so that you can put one copy on each table at your banquet."

Evaluation—"We have been advised by several sources to plan a program to encourage and expedite the hiring of science teachers in summer jobs in industrial and governmental science and engineering related positions. Before we can move ahead with confidence, we need to know what teachers think about the idea.

"If you could find one, would you take such a job for next summer?"

Exploration—"Are there groups who want to help visiting high school students exploit the science-related facilities in Washington? Would an effective method be to provide quiz sheets, the answers to which could be found only by close attention to exhibits and displays? Should there be monthly prizes for the most accurate answers? Would the advance distribution of such material help encourage science teachers to bring their students to town? Would they help chaperoning teachers handle their charges while in town? Would the quiz sheets be an appropriate way to call attention to the local organizations which promote interest in scientific, technical, and engineering careers?"

Reporting—During the first five months of the current school year, more than 120,000 pieces of FSA literature have been distributed. Fifteen hundred teachers have requested entry materials for 19,000 students. Free booklets have been requested by 600 teachers, counselors, librarians, and others. Cash orders total well over $1000. Over 4,000 copies of the booklets have been used to trigger increased distribution.

Thinking—"Bob, do you suppose the highway accident rate could be lowered if more youngsters understood the physical laws of motion as they control a speeding automobile? Would this also increase interest and enrollment in physics?"

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Audio-Visual REVIEWS

THE NUCLEAR REACTOR. 9 min. sound, 1954. $40 B&W. McGraw-Hill Textfilm Dept., 330 W. 42nd St., New York 36, N. Y.

Recommendation: Suitable for college level, although it might be used for advanced high school students in physics and chemistry.

Content: Cut from footage prepared by the U. S. Signal Corps; this follows "U-238 Series." Uses animation exclusively to discuss nuclear stability and neutron-induced fission. Develops the ideas of neutron emission, the self-sustained chain reaction, and the role of the moderator. Illustrates the application of these ideas to the atomic pile.

Evaluation: Prepared under the direction of the American Association of Physics Teachers, the film is accurate in detail. However, it drew varied ratings from the members of the Committee. It assumes a good background in physics and nuclear chemistry on the part of the viewer.

◇ ◇ ◇

LIGHT ALL ABOUT US. 11 min. sound, 1954. $55 B&W, $110 Color. Coronet Instructional Films, Coronet Bldg., Chicago 1, Ill.

Recommendation: Suitable for intermediate grades and up to seven grade general science. Should be useful to introduce the study of light.

Content: David discovers the fascinating world of light. Through observation and experimentation he finds that we see only when there is light, and that everything will reflect light. This prompts him to delve into the phenomena of both reflection and refraction. He is then able to take the facts he has learned about light and apply them to everyday use in such instruments as binoculars, magnifying glasses, mirrors, and eyeglasses.

Evaluation: Although it uses a somewhat juvenile approach, the facts presented are basic and should stimulate discussion, reading, and experimentation. Photography and sound are good. Is accompanied by a Teachers' Guide.

◇ ◇ ◇

THE MEANING OF CONSERVATION. 11 min. sound, 1954. $55 B&W, $110 Color. Coronet Instructional Films, Coronet Bldg., Chicago 1, Ill.

Recommendation: Suitable for grades five through eight. Might also be used to good advantage with adult groups. May be used effectively in the study of conservation and topography.

Content: Preserving what we have, and rebuilding what has been lost are two of the central ideas behind conservation. In this film we see what is being done to maintain our country's resources and natural beauty by limiting and regulating fishing, building dams to control floods, planting trees, and developing new farming methods.

Evaluation: Material is well-organized and timely. Should provoke interesting discussion, and should help develop needed attitudes favorable to conservation methods. Is accompanied by a Teachers' Guide.

◇ ◇ ◇

THE WONDERWORLD OF SCIENCE (BOOK 7). 12 Filmstrip Series, 1954. $36 Color. Charles Scribner's Sons, 597 Fifth Ave., New York 17, N. Y.

Recommendation: Suitable for upper intermediate and junior high level up to eighth grade in general science.

Content: Prepared to accompany Meister's *The Wonderworld of Science*, the twelve filmstrips are grouped in six pairs. Each pair develops a basic concept or generalization from each of six major science areas in the text. The following topics are covered: An Invisible Ocean; Good Water to Drink; Food in the Body; The Sun and the Earth; Changing Weather; Cooperation among Plants and Animals.

Evaluation: Although geared to a specific text, the series is well done and should prove useful as supplemental material with any textbook. The photography is excellent and each frame is captioned. Teachers' Guide is included for each pair of filmstrips.

◇ ◇ ◇

HOW MACHINES AND TOOLS HELP US. 11 min. sound, 1954. $55 B&W, $110 Color. Coronet Instructional Films, Coronet Bldg., Chicago 1, Ill.

Recommendation: Suitable for primary and lower intermediate grades in studying the many ways man has devised to make work easier.

Content: Gives a basic demonstration of simple machines we use in terms of three generalizations: we use our muscles more efficiently with the aid of simple tools such as the lever and inclined plane; we harness natural forces to work for us such as the wind and running water; we build engines and motors that work for us such as steam engines and internal combustion engines.

Evaluation: An excellent film on an elementary level that should stimulate youngsters to discuss and experiment along the lines suggested. Is accompanied by a Teachers' Guide.

◇ ◇ ◇

U-238 SERIES. 9 min. sound, 1954. $40 B&W. McGraw-Hill Textfilm Dept., 330 W. 42nd St., New York 36, N. Y.

Recommendation: Most useful on college level, although it might be used for advanced high school students in physics and chemistry.

Content: Cut from footage prepared by the U. S. Signal Corps, the film uses animated charts to trace the various stages in decay of U-238 to stable lead. Alpha emission, beta emission, and the statistical nature of the process are emphasized. Other mention of radioactive series is made.

Evaluation: Prepared under the direction of the American Association of Physics Teachers, the film is accurate in detail. However, it drew varied ratings from the members of the Committee. It assumes a good background in physics and nuclear chemistry on the part of the viewer.

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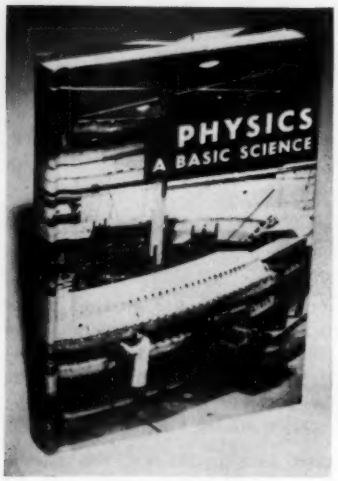

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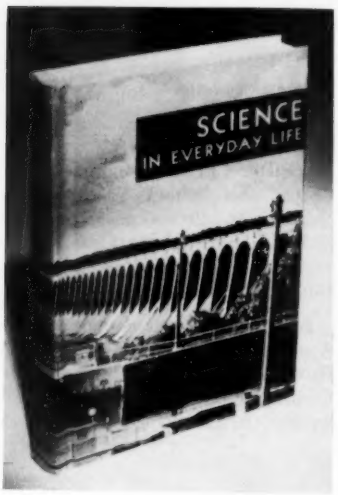

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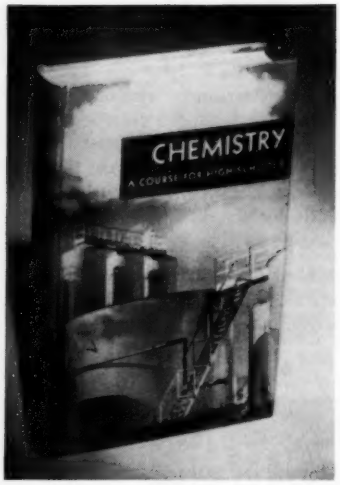

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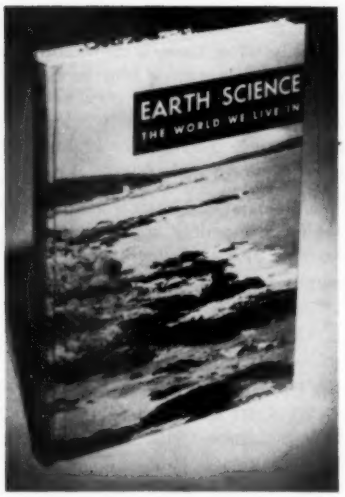

EARTH SCIENCE—
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Book Reviews

TELEVISION WORKS LIKE THIS. New Revised Edition. Jeanne and Robert Bendick. 64 pp. $2.25. Whittlesey House, McGraw-Hill Book Company, Inc. New York. 1954.

The Bendicks have done it again! Another delightful and enlightening treatment of a scientific subject, written for children (?) yet having an adult appeal.

Don't be misled by the title. Less than ten pages are devoted to the "technical" aspect of television—word-picture descriptions of the what-why-and-how of camera and receiver tubes, transmitters and antennas. Starting with an illustrated vocabulary the authors take the reader on a tour, from the studio floor, backstage, through the TV camera, control room, transmitter, and into the home receiver. Along the way he meets the station personnel, learns their duties and problems, and watches preparations and rehearsals. The reader is shown techniques and equipment peculiar to television, and discovers the countless details that must be planned, prepared and synchronized, so that he may sit at home and view the diverse activities that are taking place simultaneously, around the corner, in the next community, across the nation, or around the world.

Every page is garnished with lucid and clever drawings, which, with their titles, almost make the text superfluous. Far superior to photographs, the sketches are an outstanding feature of the book.

The revised edition includes descriptions of color television, educational TV (much too brief to be "featured," unfortunately), network alignments, and an outline of television's role in our civilization.

This entertaining little book instructs painlessly and humorously. It can be recommended for (1) general reading, (2) classroom use (vocabulary and concepts might set the lower limit at junior high school general science), (3) teachers and parents trying to keep abreast of today's youngsters, and (4) any curious adult who is interested in penetrating the seeming mysteries of television.

DON MCBRIEN
Television Film Producer
Jackson, New Hampshire

INTRODUCTION TO ASTRONOMY. Cecilia Payne-Gaposchkin. 508 pp. Illustrated. $6.00. Prentice-Hall, Inc. New York. 1954.

This *new* text for introductory astronomy courses has been carefully prepared by Cecilia Payne-Gaposchkin, Phillips Astronomer at the Harvard Observatory. The book is aimed at the "liberal arts student who is 'fulfilling a science requirement.'" With this in mind she "has been at pains to point out associations with the fields of language, literature, and history. Astronomy has played no small part in the cultural development of the human race." Here the beginning student or interested teacher can clearly see astronomy as part of the intellectual development of science and of our culture.

Written carefully and interestingly, this book is filled with up-to-date information and interpretations. The introductory chapter is followed by one on the earth; then comes "Tools and Methods." Here the student is provided with information on reference systems, time systems, radiation phenomena and spectroscopy, optical instruments and photography. The planetary system, beginning with the sun, is then considered through the remainder of the first half of the volume. The discussion of stars and stellar organizations in the second half is similar to her *Stars in the Making*, recently reviewed in this journal. Problems and thought questions are grouped after the appendices.

An excellent book for reading and reference.

FLETCHER G. WATSON
Harvard Graduate School of Education
Cambridge, Massachusetts

CHEMISTRY TODAY. Harry C. Biddle and George L. Bush. 722 pp. $4.20. Rand McNally and Company. New York. 1954 (Revised Edition).

This conventional high school text is organized into 19 units with each unit divided into three or four areas. Self-checking questions occur within and after areas. A vocabulary list, thought questions, and problems conclude units.

A three-page appendix contains: metric equivalents, a water vapor pressure table, the element table, a gas density table. Solubility and periodic charts (including an 18 group periodic) are within the text. Text covers are not utilized. A short bibliography is included.

Photographs (fewer than the number in other modern texts) are interesting and show practical applications. Type, set in one column, is larger than that in most texts. Readability is nearly average for high school juniors. Described experiments support theories and principles. Nuclear energy requires an area; plastics, a unit; chemistry and health, a unit. Formulas and equations, and acids and bases precede atomic structure. No changes over the 1949 edition are apparent.

VIOLET STRAHLER
Stivers High School
Dayton, Ohio

UNSEEN LIFE OF NEW YORK—AS A NATURALIST SEES IT. William Beebe. 165 pp. $4.00. Duel, Sloan and Pearce, New York; Little, Brown and Company, Boston, 1953.

Most people find natural histories fascinating. This one is unusual in that it deals with organisms in and around a large city. City dwellers, in New York and elsewhere, will enjoy the panorama of ordinarily unseen life presented against an evolutionary and embryological backdrop. Mr. Beebe exposes to view those living things which exist and have existed within a hundred mile radius of New York City. Among these are those organisms which are too old to be seen; those too young to be seen; those too small and

those camouflaged; those which migrate at too great a height; those nocturnal; and those which live at great marine depths.

Sophisticated New Yorkers will be surprised to learn that mastodons once paraded along what is now Broadway and that opossums exist on Long Island. A popular styled, readable, urban natural history, *Unseen Life of New York,* is recommended for adults and as supplementary reading for high school pupils.

MILTON LESSER
Thomas Jefferson High School
Brooklyn, New York

ALL ABOUT THE WONDERS OF CHEMISTRY. Ira Freeman, Illustrated by George A. Wilde. 148 pp. $1.95. Random House, New York. 1954.

This latest in the Random House series of "All About Books" brings to the junior high school level a readable and accurate description of modern chemistry. After tracing the evolution of scientific thought from Aristotle, through the alchemists, to the pioneering work of Priestley and Lavoisier, the reader arrives at the present situation in chemistry. The author explains in detail why and how atoms form molecules, with considerable emphasis on organic chemistry and structural formulas.

The major portion of the book concerns the role of chemistry in nutrition, chemotherapy, and agriculture; in the refining of metals and petroleum products; and in the manufacture of rubber, plastics and synthetic fibers. The book briefly describes some applications of chemistry in other industrial processes and concludes with a review of the employment opportunities in the science. As a whole, this is an excellent presentation of the subject for anyone interested but lacking a scientific background.

DOUGLAS A. BLY
Spencerport Central School
Spencerport, New York

FUNDAMENTALS OF COLLEGE CHEMISTRY. G. Brooks King and William E. Caldwell. 597 pp. $4.50. American Book Company, New York. 1954 (Second Edition).

Fundamentals of College Chemistry is a well written textbook. It presents basic principles and practical applications in readable and interesting style.

The theory of atomic structure, with some discussion of quantum numbers and subshells, is introduced near the beginning of the book. The elements and compounds selected for description are those having considerable importance. Atomic structure diagrams are provided for all elements which are treated in detail. Other features of this text include: an introduction to organic chemistry encompassing two chapters of the book; a fairly extensive and up-to-date treatment of radioactivity and nuclear reactions; and a rather thorough treatment of such topics as ionic equilibria, electrochemistry, periodic classification, valence and oxidation-reduction.

The book provides numerous good study helps. The appendix includes an excellent glossary. There are 604 problems with answers for approximately half this number. Sample solutions for various types of problems are given throughout the text. The illustrations are adequate, but not outstanding. The chapter bibliographies include books and periodicals of recent publication.

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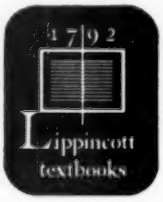

J. B. LIPPINCOTT COMPANY Chicago Philadelphia **SCIENCE TEXTS**

The high school teacher will find this book to be useful for personal reference as well as for reference by interested high school pupils.

LELAND L. WILSON
Georgia Teachers College
Collegeboro, Georgia

THE TEACHING OF SCIENCE IN TROPICAL SCHOOLS. E. D. Joseph. 234 pp. Price in (U. K. only) 7s 6d net. Oxford University Press. 1953. Volume I of the UNESCO HANDBOOKS ON THE TEACHING OF SCIENCE IN TROPICAL COUNTRIES.

A casual scrutiny may give an impression that the book is more or less of a hodge-podge. A more careful examination reveals that the author has recognized the magnitude of her undertaking. She has attempted to provide some things of value for every teacher, regardless of the teacher's background or of the situation in which he works. The author's awareness of the above implications is indicated many times. A few quotations will exemplify what is meant; Page 1, ". . . a syllabus *must* be related to the *local* climate, plants and animals, agriculture, crafts and industries, etc. The teacher must first examine the syllabus he has to use in his school; then he can refer to the outline in this book and quickly find the topics he wants." Page 51, "What you teach will depend upon; —the school authorities, —the environment of the school, —your pupil's home background, —the school time-table, and —the ability and ages of your pupils. This means that *you* have to think out what will be best for *your* pupils. Everything depends on *your* circumstances.

The scope of the book is indicated by the following chapter headings: Preparation for Science Teaching, Practical Work in Elementary Science, Primary School Science Materials, Teaching Science in the First Year, Teaching Science in the Second Year, Teaching Science in the Third Year, Teaching Science in the Fourth Year, Teaching Science in the Fifth Year, and Teaching Science in the Sixth Year. The book is illustrated and includes a list of materials and a bibliography.

JULIAN GREENLEE
Florida State University
Tallahassee, Florida

CHEMISTRY FOR THE NEW AGE. Robert H. Carleton, in consultation with Floyd F. Carpenter, R. W. Woline, and W. R. Teeters. 688 pp. $4.12. J. B. Lippincott Company. Chicago. 1954 (Revised Edition).

Chemistry for the New Age is an exceptionally good high school textbook which provides both general education for all students and the necessary foundation for students who intend to specialize in scientific studies in college. The objectives stated in the preface are directly and efficiently achieved: (1) by the arrangement of the subject matter in a simple, orderly, and logical unit plan of presentation; (2) by the "life-problem" approach that stimulates student interest and emphasizes the relationship of subject matter to everyday problems; (3) by the simple but dignified style with which the student is addressed.

Special features of this text which add to its excellence include a generous and extensive glossary; the quality and abundance of well captioned illustrations; a program of learning exercises following each problem and completing each chapter; a technique affording ample opportunity for employing elements of scientific problem solving; and a bibliography of interesting and related readings following each unit, which are valuable to both the student and instructor. This revised edition includes recent developments in the fields of radioactive isotopes in medicine, soil, and textile chemistry.

CHARLES D. ERCEGOVICH
The Pennsylvania State University
State College, Pennsylvania

DINOSAURS. Herbert S. Zim. 64 pp. $2.00. William Morrow and Company, Inc. New York. 1954.

Once again Dr. Zim presents an appealing book to girls and boys that is scientifically accurate. An excellent introduction that deals with the formation of fossils, is followed by a comparison of amphibians and reptiles. The major portion of the book is an easily understood discussion of the largest and most popular dinosaurs. Some of the scientific guesses concerning the reason why dinosaurs became extinct are described in an exceptional fashion. Every page contains the outstanding black and white illustrations of James Gordan Irving. This book on dinosaurs gives librarians and science teachers a source book of clearly stated information. Children of many ages will be interested in the stimulating story of the Age of Reptiles. Perhaps the sixth grade will find the vocabulary, as well as the understandings most suitable. However, it can be used very well through the junior high school years to a great advantage. This book gives the complex, but popular subject of dinosaurs a new and attractive approach.

FLORENCE E. LEARZAF
Horace Mann and John Morrow Schools
Pittsburgh, Pennsylvania

PHYSICS—THE STORY OF ENERGY. Brown and Schwachtgen. 596 pp. $3.80. D. C. Heath and Company. Boston. 1954.

The authors have used a most interesting approach to the study of physics in that they present the more familiar subjects first, thereby immediately stimulating interest and early mastery of principles. Unlike the traditional sequence of Physics Units this book deals first with Sound Energy followed by Light, Machines, Electricity, Motion and Heat.

Each chapter presents several problems with a most complete discussion of those problems incorporated in it. For example Chapter One poses the following problems: How do certain sounds affect us and how are they measured? How are rooms treated to make for better listening conditions? Immediately the student is made aware of his body reactions to sound and how sound affects his home life?

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Adequate study aids are offered in the numerous illustrations, some in color, simplifying the understanding of basic principles. Each chapter ends with a summary, things to do section, questions, problems, and references to further help the student.

The appendix presents material on the mathematics of physics; a knowledge of elementary algebra and some geometry is adequate in the understanding of basic relationships. Useful tables, charts and a 400 word glossary are included.

E. BERNER CLARKE
Kenmore Senior High School
Kenmore, New York

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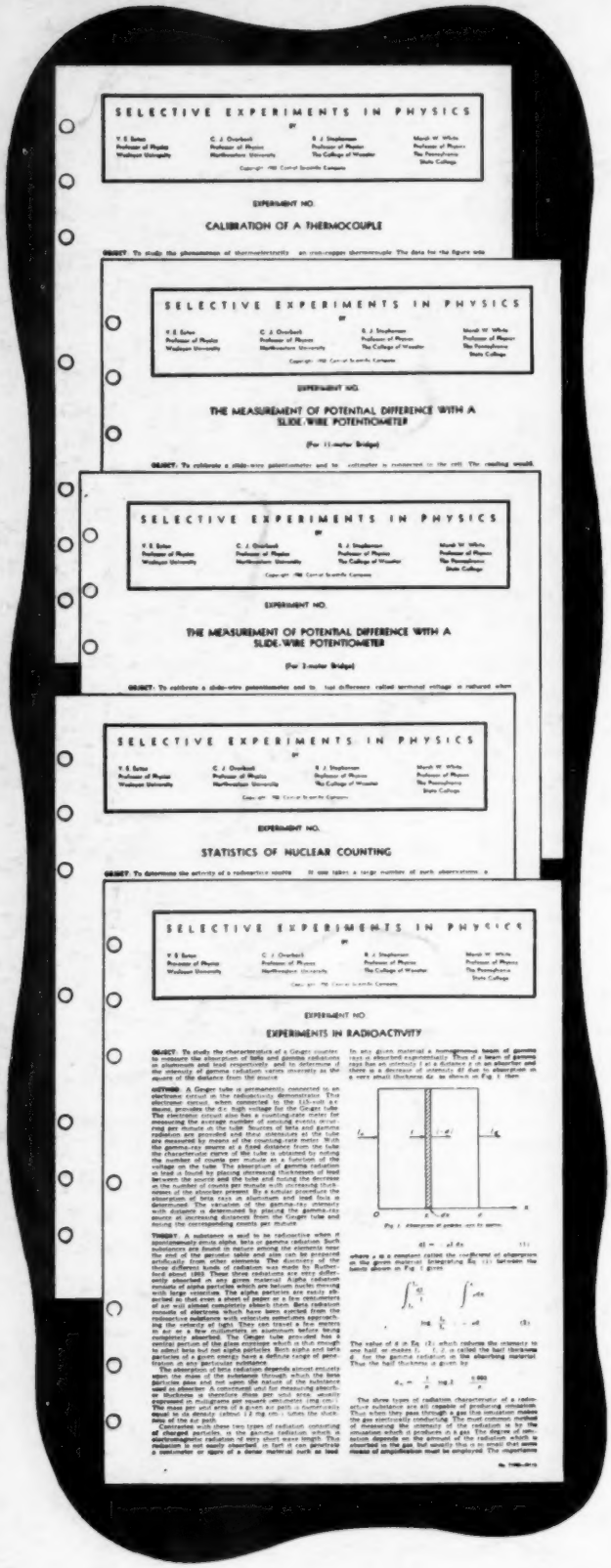
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